Computer Access Technology Corporation

3385 Scott Blvd, Santa Clara, CA 95054 Tel: +1/408.727.6600 Fax: +1/408.727.6622

CATC Merlin II™

Bluetooth™ Protocol Analyzer

User's Manual

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This equipment has been tested and found to comply with the limits for a Class A digital device and an intentional radiator, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense. The end user of this product should be aware that any changes or modifications made to this equipment without the approval of CATC could result in the product not meeting the Class A limits, in which case the FCC could void the user's authority to operate the equipment.

Important Notice: To comply with FCC RF exposure requirements (sections 1.1307 and 1.310 of the Rules) only the antenna supplied by CATC must be used for this device. The antenna must be located at least 20 cm away from all persons.

FCC Testing applies to FCC ID: KH7BT006UAA-X.

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This equipment complies with the R&TT Directive 1999/5/EC. It has been tested and found to comply with EN55022:1994/A1:1995/A2:1997 Class A, EN61000-4-2:1995, EN61000-4-3:1995, EN61000-4-4:1995, EN61000-4-5:1995, EN61000-4-6:1995, EN61000-4-11:1994, EN61010-1:1993, and ESTI EN 300 328-1 V1.2.2 (2000-07).

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1. Overview

The CATC Merlin II™ Protocol Analyzer is the newest member of CATC's industry-leading line of high performance, Bluetooth protocol analyzers. Preceded by CATC's BT*Tracer*™, Merlin™ and Merlin Mobile™ Analyzers, Merlin II has been designed using the same modular architecture that made its predecessors highly successful in the serial bus protocol analyzer market worldwide.

1.1 Bluetooth™ Overview

The Bluetooth wireless technology is set to revolutionize the personal connectivity market by providing freedom from wired connections. It is a specification for a small-form factor, low-cost radio solution providing links between mobile computers, mobile phones and other portable handheld devices, and connectivity to the internet.

The Bluetooth Special Interest Group (SIG), comprised of leaders in the telecommunications, computing, and network industries, is driving development of the technology and bringing it to market. The Bluetooth SIG includes promoter companies 3Com, Ericsson, IBM, Intel, Lucent, Microsoft, Motorola, Nokia and Toshiba, and more than 2500 SIG members.

Bluetooth is a radio technology specification designed to transmit both voice and data wirelessly, providing an easier way for a variety of mobile computing, communications and other devices to communicate with one another without the need for cables. Bluetooth could make possible what is being called the personal-area network by allowing users to transmit small amounts of data at 1M bit/sec with a range of 10 to 100 meters, depending the power of the radio, over the 2.4-GHz radio frequency. The key benefits of the Bluetooth technology are robustness, low complexity, low power and low cost. Bluetooth employs a rapid frequency hopping mechanism to minimize the effects of *'collisions'* with other protocols and devices operating in the same frequency band. Mechanisms exist for a Bluetooth device to determine all devices in range as well as to request connection to a piconet as either a master or a slave.

Please refer to the *Bluetooth Specification, version 1.2* for details on the protocol. The Bluetooth specification is available from the Bluetooth SIG at its web site **http://www.bluetooth.org/**

1.2 General Description

The Merlin II Protocol Analyzer is designed as a stand-alone unit that can be easily configured and controlled by a portable or desktop PC connected via its USB port. Merlin II provides users with the familiar 'CATC Trace' user interface that is the *de facto* industry standard for documenting the performance of high-speed serial protocols.

Merlin II supports the functionality required to analyze all levels, including the baseband, of the Bluetooth wireless protocol. The featured Radio Interface allows users to probe and analyze transactions at the lowest level within the Bluetooth architecture. By creating this "Point of Observation" or probing point within the radio level packet view, the user can analyze all levels of the protocol stack.

Merlin II is a non-intrusive testing tool for Bluetooth piconets providing network traffic capture and analysis. Hardware triggering allows real-time events to be captured from a piconet. Hardware filtering allows the filtering out of fields, packets, and errors from the recording. Filtering allows users to focus recordings on events of interest and to preserve recording memory so that the recording time can be extended.

Recorded data is presented in colored graphics in a trace viewer application. This application has advanced search and viewing capabilities that allow the user to quickly locate specific data, errors and other conditions, thereby focussing the user's attention on events of interest.

Merlin II functions with any personal computer using the Windows 98SE, Windows 2000, Windows ME, or Windows XP operating systems and equipped with a functional USB interface. For an updated set of system requirements for the host machine, please refer to the readme file.

The Analyzer is configured and controlled through a personal computer USB port. It can be used with portable computers for field service and maintenance as well as with desktop units in a development environment. The Analyzer is easily installed by connecting a cable between the computer's USB port and the Analyzer's USB port.

Merlin II provides on-the-fly detection of and triggering on such events as Packet Headers and Errors. Whether recording manually or with a specified trigger condition, Merlin II continuously records the bus data in a wrap-around fashion until manually stopped or until the Trigger Event is detected and a specified post-Trigger amount of bus data is recorded.

Upon detection of a triggering event, the analyzer continues to record data up to a point specified by the user. Real-time detection of events can be individually enabled or disabled to allow triggering on events as they

happen. This includes predefined exception or error conditions and a user-defined set of trigger events. The unit can also be triggered by an externally supplied signal. The breakout board provides a path for externally supplied trigger or timing data to be recorded along with bus traffic.

The breakout board also provides a path for Merlin II to transmit a trigger signal.

The Merlin II software provides powerful search functions that enable investigation of particular events and allow the software to identify and highlight specific events. In addition to immediate analysis, you can print any part of the data. Use the **Save As** feature to save the data on disk for later viewing. The program also provides a variety of timing information and data analysis reports.

1.3 Automation

The Merlin II software includes an Application Program Interface (API) for developing testing programs and scripts in C++ and Visual Basic. The API reproduces most of the commands embodied in the Merlin II trace viewer software. This API allows users to automate procedures that otherwise have to be run manually via the trace viewer software. The Automation API can be run locally on the PC attached to Merlin II or remotely over a network connection.

For further details, refer to the *Automation API for CATC Bluetooth Analyzers* reference manual included in the installation CD-ROM. You can also download the document from the CATC website.

1.4 Features

General

- Small form factor for mobility and easy placement.
- Flexible design - reconfigurable hardware for future enhancements.
- User friendly - the Graphical User Interface software of Merlin II Analyzer is designed to be consistent with the 'CATC Trace' using color and graphics to display Bluetooth traffic.
- Radio Level Point of Observation and Capture - traffic capture at the Radio Level for comprehensive analysis.
- Complies with Bluetooth v1.2 specification.
- Supports point-to-point and point-to-multipoint Bluetooth piconets.
- Spool data to hard drive allowing for long recording sessions.

- Automatic tracking of ESCO and Anonymity Modes.
- Supports 79 frequency hop standards, reduced frequency, fixed frequency, and AFH.
- Automatic tracking of changes in the hopping scheme.
- Automatic tracking of whitened and non-whitened packets and traffic.
- Real time viewing of events and statistics.
- Free non-recording, view-only software available.
- Power-on self-diagnostics.
- Compliant with FCC class A requirements / meets all CE mark requirements.
- Three year warranty and hot-line customer support.

Physical Components

Note For an updated description of requirements for the host machine, please refer to the readme file.

- External small "power brick." Can also be powered by PS/2 power cable.
- Trace viewer software support for Microsoft Windows versions 98SE and later.

Display Options

- Analyzes and displays a transaction-level view of piconet traffic with accurate time-stamps and frequency hop information.
- Software analysis and data presentation at several protocol levels: Baseband, LMP, HCI, L2CAP, SDP, RFCOMM, TCS, OBEX, HDLC, BNEP, PPP, AT, HCRP, IP, TCP, UDP, HID, AVCTP, and AVDTP.
- Supports the following profiles: GAP, CIP, CTP, HCRP, HID, Intercom Profile, LPP, PAN, SDAP, SPP, UDI, DUN, FAX, GEOP, HF, HP, LAN, PAP, SAP, VCP, BPP, BIP, FTP, OPP, Synchronization Profile, GAVDP, A2DP, AVRCP, VDP

Recording Options

- Flexible advanced triggering capabilities including - multiple triggering modes, selective views, timing analysis, search functions, protocol packet errors, transaction errors, packet type and destination device, data patterns, or any of these trigger types in combination.
- User defined trigger position.
- Support for various piconet characteristics by enabling the user to configure the synchronization method and recording parameters.

- Real-time hardware filtering of captured traffic for optimizing analyzer memory usage.

Bluetooth BusEngine

CATC's BusEngine™ Technology is at the heart of the new Merlin II Analyzer. The revolutionary BusEngine core uses state-of-the-art FPGA technology and incorporates both the real-time recording engine and the configurable building blocks that implement data/state/error detection, triggering, capture filtering, external signal monitoring and event counting & sequencing. And like the flash-memory-based firmware that controls its operation, all BusEngine logic is fully field upgradeable, using configuration files that can be downloaded from the CATC Website.

1.5 Specifications

Package

Width:	6.05 inches (15.5 cm)
Depth:	3.0 inches (7.6 cm)
Height:	1.07 inches (2.7 cm)
Weight:	8.8 oz (246 grams)

Power Requirements

5V, 800mA

The provided external power supply operates on 100V-240V AC 50Hz - 60A

Connectors:	DC power connection (for connecting the external power supply or the PS/2 power cable) Mini DIN Host connection (USB, type 'B') Antenna (reverse polarity SMA)

Radio

Bluetooth v1.1 qualified
Class 2
FCC and CE compliant

Environmental Conditions

Operating Range:	0 to 55 °C (32 to 131 °F)
Storage Range:	-20 to 80 °C (-4 to 176 °F)
Humidity:	10 to 90%, non-condensing

LEDs

Status (STATUS)	Illuminates blue when the analyzer is functioning properly
Synchronized (SYNC):	Flashes yellow during acquisition of the traffic hop sequence, illuminates when analyzer is locked to the hop sequence.
Recording (REC):	Illuminates green when analyzer is actively recording data.

Recording Size

Internal 32 MB and Disk spooling capabilities provide large virtual memory for long for recording sessions

Host Compatibility

Requires a PC with a USB port

Supports Windows 98/ME/NT/2000

2. Installation

The Merlin II Protocol Analyzer components and software are easily installed and quickly ready to run on most Windows-based personal computer systems. You can begin making Bluetooth recordings after following these initial steps.

2.1 System Components/Packing List

- One stand-alone Merlin II Analyzer
- One Antenna
- One External Interface Breakout Board with a Mini DIN cable
- One External Power Supply
- One PS/2 Power Cable
- One USB cable
- Merlin II software program installation CD
- User's Manual

2.2 Analyzer LED Descriptions

The Merlin II analyzer has three LEDs. From left to right, these LEDs are:

A Blue **Status** indicator LED Blinks fast during initialization/power up. Stead on if unit is functioning properly. Blinks slowly if a self-test fails..

B Yellow **Sync** (Synchronize) LED (Flashing indicates that the analyzer is tracking the defined slave or master device. Illuminated indicates that the analyzer is tracking an active piconet.)

C Green **Rec** (recording) LED (lights when the unit is recording).

2.3 Rear Panel Description

USB type "B" host computer connector

This connector links the analyzer to the PC that will be administering it.

Mini DIN Connector

This connector allows the analzyer to transmit and receive external signals via a mini DIN cable to a Break Out Board for the purpose of triggering on external input signals and for clock calibration.

Power connector for external power supply

This connectors is used to attach the external power supply or for connecting the analyzer with the provided PS/2 cable from a mouse or keyboard serial port on the PC or laptop. The PS/2 cable is a pass-through type that allows you to connect the cable to the PC and then plug the mouse or keyboard into the back of the PS/2 cable.

2.4 Setting Up the Analyzer

To set up a Merlin II system,

Step 1 Attach the Antenna to the ANT connection point on the analyzer. The antenna should point up.

Step 2 Connect the provided external power supply to the analyzer and then to a 100-volt to 240-volt, 50 Hz to 60 Hz, 100 W power outlet. Alternatively, you can connect the PS/2 cable into the analyzer and one of your PS/2 ports (i.e. keyboard or mouse ports). The keyboard or mouse would then plug into the back of the PS/2 cable.

Note At power-on, the analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. The status LED flashes during the power-on testing and turns on steadily if the unit is functioning properly when testing is finished. If the diagnostics fail, the status LED blinks slowly, indicating a hardware failure. If this occurs, call CATC Customer Support for assistance.

Step 3 Connect the USB cable between the USB port on the back of the analyzer and a USB port on the analyzing PC.

The host operating system detects the analyzer and begins to install the USB driver.

2.5 Installing the Analyzer Software on the PC

Once Merlin II has been recognized as a USB device, install the Merlin II software on the PC administering the analyzer.

Step 1 Insert the Merlin II Suite CD into the CD ROM drive of the PC that will be administering the Analyzer.

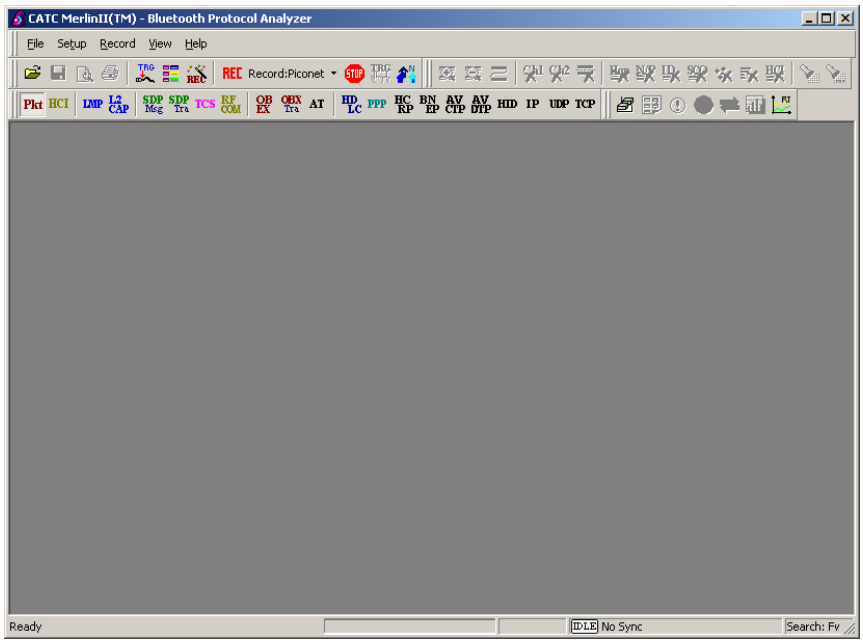
Step 2 Follow Windows on-screen Plug-and-Play instructions for the automatic installation of the Merlin II Analyzer as a USB device on your analyzing PC (the required USB files are included on the Merlin II CD.

Step 3 Select **Install Software** from the installation CD and follow the on-screen installation instructions.

The Merlin II application will install on the PC hard disk.

Step 4 To start the application, launch the **CATC Merlin II** program from the **Start Menu: Start>Programs>CATC>Merlin II**.

The Merlin II program opens.

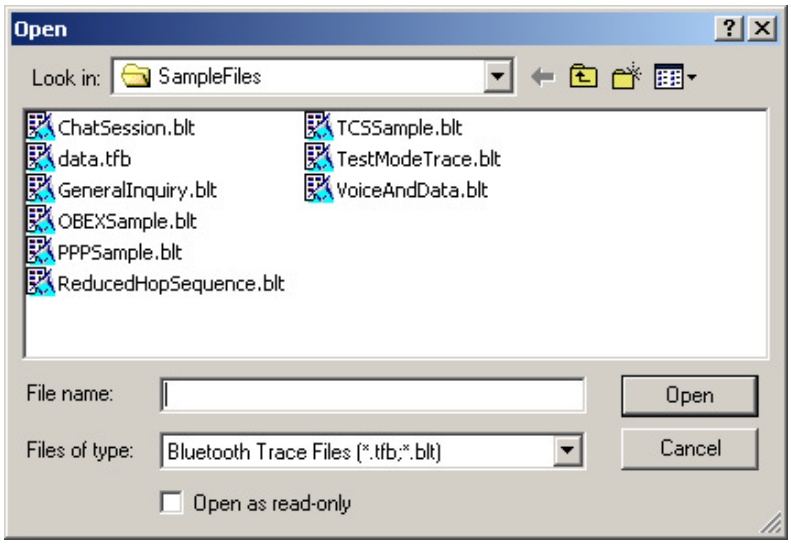


The window shows a menu bar and toolbar at the top, a grey trace viewing area covering most of the window, and a status bar at the bottom.

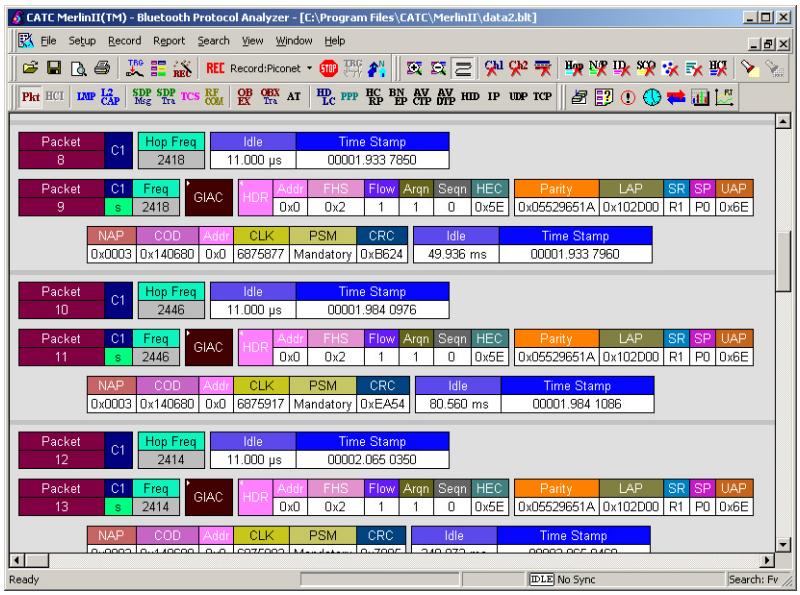
Opening a sample trace will cause most of the buttons on the toolbar to become active.

To open a trace,

Step 1 Select **File** > **Open** from the menu. A dialog box opens.



Step 2 Select a file from the dialog box and click **Open.** A trace opens in the main viewing area. When traffic has been recorded, it will display here.


CATC MerlinII(TM) - Bluetooth Protocol Analyzer - [C:\Program Files\CATC\MerlinII\data2.blt]
File Setup Record Report Search View Window Help
Ready
No Sync

Note The software may be used with or without the analyzer box. When used without an analyzer box attached to the computer, the program functions as a Trace Viewer to view, analyze, and print captured protocol traffic.

2.6 Your First Bluetooth Recording

After installing and launching the software, you can test Merlin II by creating an inquiry recording. In this test, Merlin II will issue a General Inquiry that asks local devices to identify themselves. Merlin II then records the responses.

Inquiry Recording

To create an inquiry recording, perform the following steps:

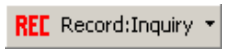
Step 1 Click the down-arrow on the right side of the **Record:Piconet** button on the toolbar

.

A sub-menu appears with options for **Piconet Recording Mode**, and **Inquiry Recording Mode**.

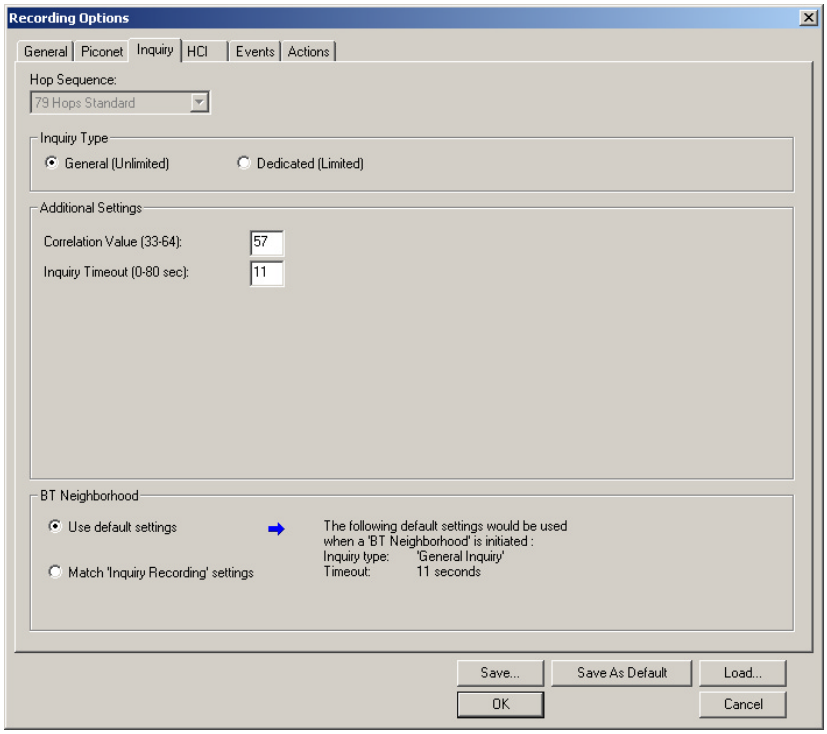
Step 2 Select **Inquiry Recording Mode**.

The button changes appearance and shows the label **Record: Inquiry**



Step 3 From the menu, select **Setup** > **Recording Options**.

The Recording Options dialog opens with the **Inquiry** page displaying.



Step 4 If desired, make any changes to the options, then click **OK.**

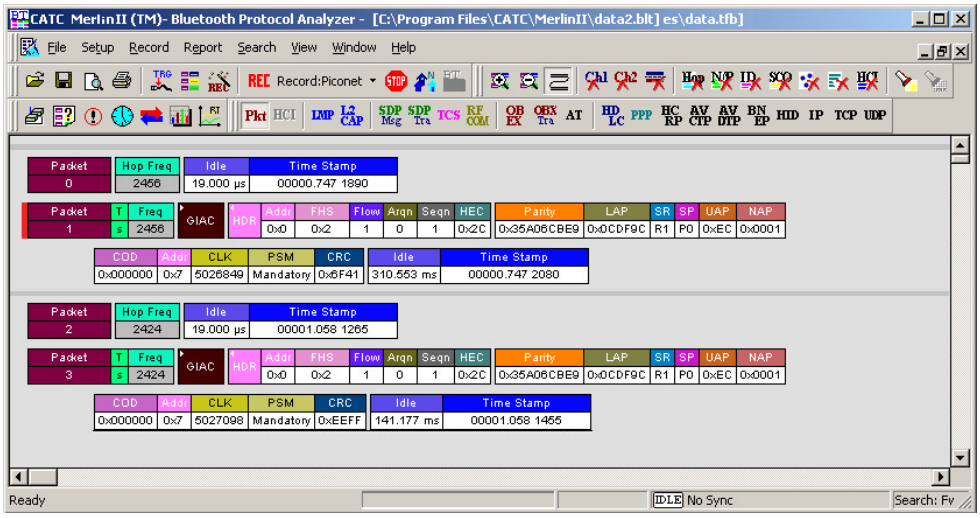
Step 5 Click the

button (i.e. not the down-arrow.)

Merlin II starts to record the Bluetooth traffic immediately using the settings from the Piconet page in the Recording Options dialog. The Bluetooth Inquiry process will proceed for whatever amount of time is set for creating an Inquiry action (the default is 11 seconds). After the inquiry time has elapsed, the analyzer will upload the data and display the packets. In addition, the Device List window will open and display the updated statuses of the devices.

The screen should look like the sample recording below which shows the FHS packets generated during the Inquiry process.

When the recording session is finished, the bus traffic is saved to the hard drive as a file named **data.tfb** or whatever name you assign as the default filename. While the file is being saved, you should see a brown progress bar at the bottom of the screen. When the bar turns white, it indicates that the data has been saved to disk.

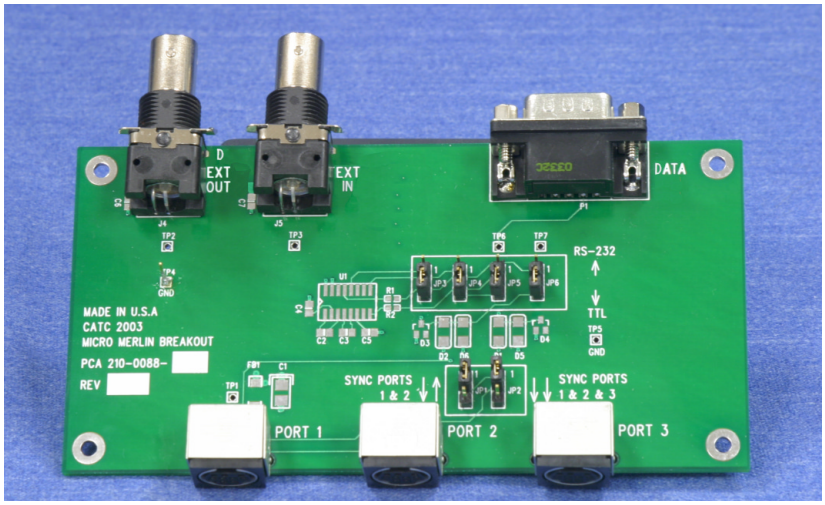

CATC MerlinII (TM)- Bluetooth Protocol Analyzer - [C:\Program Files\CATC\MerlinII\data2.blt] es\data.tfb]
File Setup Record Report Search View Window Help
REC Record:Piconet
Packet 0 Hop Freq 2456 Idle 19.000 µs Time Stamp 00000.747 1890
Packet 1 T Freq s 2456 GIAC HDR Addr 0x0 FHS 0x2 Flow 1 Arqn 0 Seqn 1 HEC 0x2C Parity 0x35A06CBE9 LAP 0x0CDF9C SR R1 SP P0 UAP 0xEC NAP 0x0001
COD 0x000000 Addr 0x7 CLK 5026849 PSM Mandatory CRC 0x6F41 Idle 310.553 ms Time Stamp 00000.747 2080
Packet 2 Hop Freq 2424 Idle 19.000 µs Time Stamp 00001.058 1265
Packet 3 T Freq s 2424 GIAC HDR Addr 0x0 FHS 0x2 Flow 1 Arqn 0 Seqn 1 HEC 0x2C Parity 0x35A06CBE9 LAP 0x0CDF9C SR R1 SP P0 UAP 0xEC NAP 0x0001
COD 0x000000 Addr 0x7 CLK 5027098 PSM Mandatory CRC 0xEEFF Idle 141.177 ms Time Stamp 00001.058 1455
Ready
IDLE No Sync
Search: Fv

Step 6 To save a current recording for future use, select **File** > **Save As** or click on the tool bar.

You see the standard **Save As** screen.

Step 7 Give the recording a name and save it to the appropriate directory.

2.7 External Interface Breakout Board

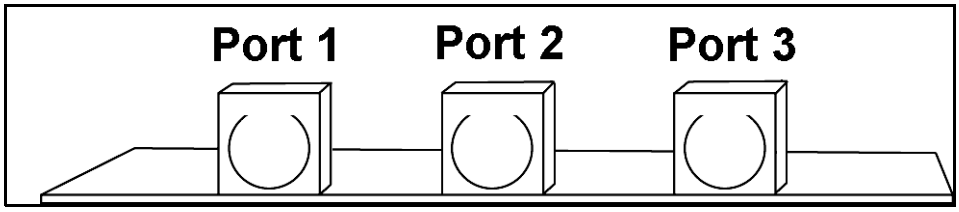


The External Interface Breakout Board is an accessory that allows standard, LV TTL signals to be connected to the analyzer for triggering. The breakout board consists of two BNC connectors for "EXT IN" and "EXT OUT" signals. The EXT IN connector can be used to import trigger signals from other devices. the EXT OUT connector can be used to export trigger signals to trigger other devices such as oscilloscopes or logic analyzers or to export the external clock for clock calibration using a frequency counter (see Appendix A).

Drive strength for all outputs is about 30mA high (@2V) and 60 mA low (@0.5V). Inputs can handle 0 to 5.5V. Inputs above 2V are detected as logic high; inputs below 0.8V are detected as logic low.

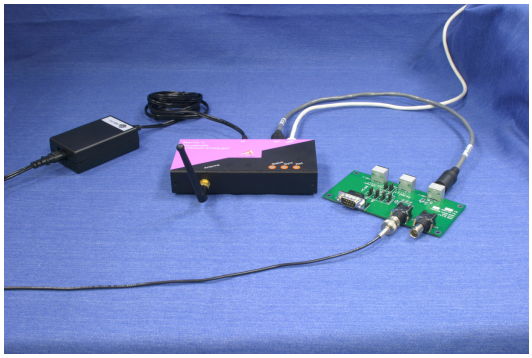
The analyzer connects to the first of three mini DIN ports ("Port 1") on the Breakout Board. Each signaling pin is isolated by a 100Ω series resistor and a buffer inside the Analyzer unit.

Please make sure that the jumpers JP1 and JP2 on the breakout board are set to Position 1.



Mini DIN connectors on the back of the Break-out board.

Connecting the Breakout Board



Merlin II with power supply (left) and Breakout board (right).

The photograph above shows a fully connected Merlin II.

The following connections can be seen: **Left**: Power supply connected to the power port on the analyzer. **Center**: Mini DIN cable leading to Port 1 of the breakout board. USB cable leading to an offscreen PC. **Right**: BNC cable leading from the Breakout board to an offscreen device on the left.

Configuring the Analyzer for the Breakout Board

To configure the analyzer for the breakout board, see section "Save External Interface Signals" on page 68, and section "External Input Signals" on page 88.

3. Updates

BusEngine and Firmware updates often need to be performed when you update the Merlin II software. These updates can be performed automatically or manually. Both processes are described.

3.1 Update Files

Update files are installed with the Merlin II software during the installation procedure and reside in the local directory of the analyzer application. During the update process, the files are taken from this location.

The following update files are provided with each release:

BusEngine - For updating the hardware logic (has an *.bin extension).

Firmware- For updating the platform firmware (has an *.hex extension).

3.2 Automatic Updates

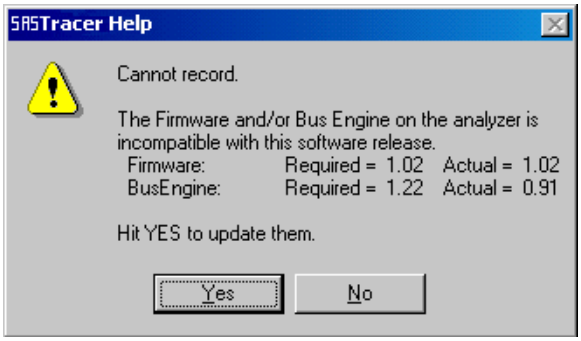
When you update the analyzer software, the software may become incompatible with the BusEngine and Firmware. After the analyzer is powered on, the analyzer will display an error message telling you that it needs to update the Firmware and/or BusEngine. When you click OK, the update process takes place automatically.

To update the BusEngine and/or Firmware, follow these steps:

Step 1 If needed, update the analyzer software, following the steps outlined in "Software Updates."

Step 2 Turn on the analyzer.

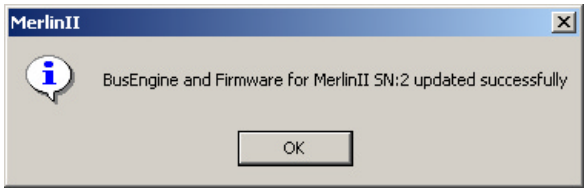
Because the BusEngine and/or the Firmware are incompatible with the current analyzer software version, an error message appears showing your current versions and indicating what versions you need to install.


SASTracer Help
Cannot record.
The Firmware and/or Bus Engine on the analyzer is incompatible with this software release.
Firmware: Required = 1.02 Actual = 1.02
BusEngine: Required = 1.22 Actual = 0.91
Hit YES to update them.
Yes
No

Step 3 Click **Yes**.

The update process begins.

When the update has finished, a message such as the following appears and tells you that the update is complete. The example below follows a BusEngine update.



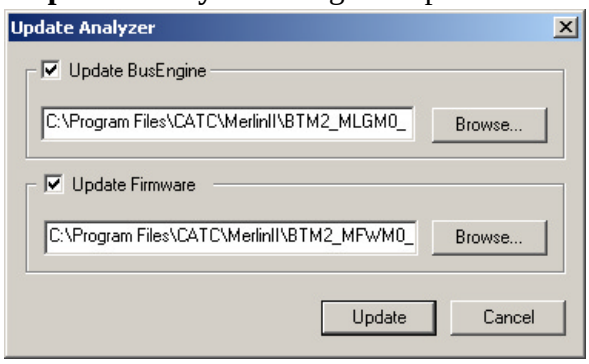
Step 4 Click **OK**.

Manual Updates

If you prefer, you can manually update the Firmware, and/or BusEngine through the 'Analyzer Setup' dialog. To do this follow these steps:

Step 1 Select from the menu: **Setup** > **Update BE/FW ...**.

The **Update Analyzer** dialog box opens.



Step 2 Select the one of the entity that you want to update from the list.

Step 3 If needed, browse to the application directory to locate the Update files.

Step 4 Click the **Update** button.

At this time, the application would start the update process. A progress bar in the dialog would show the progress of the update process.

Please note that in some cases this process can take several minutes to complete.

Step 5 When a the application notifies that the update process is done, you may need to cycle the analyzer's power to cause the program to take effect, or you may need to unplug and then reconnect the USB cable

between the analyzer and the computer to cause the new firmware upgrade to take effect.

3.3 Software, Firmware, and BusEngine Versions

The **Readme.html** file on the installation CD and on the installed directory on your hard drive. This file gives last-minute updates about the current release. Included with each release are the most recent downloadable images of the Firmware and the BusEngine.

Once the Merlin II has completed the self diagnostics and is connected to the PC, you can check the latest version of the software and BusEngine.

To check information about the current software, select **About Merlin II …** from the **Help** menu.

The About Merlin II window appears.

About Merlin II details revisions of the following software and hardware:

- Software Version and Build Number
- Product Name
- Firmware Version
- BusEngine Version
- Unit Serial Number

Note When contacting CATC for technical support, please have available all the revisions reported in the **About Merlin II** window.

3.4 Software Updates

When a new software release is available, it is posted on the Support page of the CATC website at

www.catc.com/support.html.

The software is also available on CD from CATC.

Updating from CD-ROM

To update the software from CD-ROM, follow these steps:

Step 1 Load the CD-ROM into the CD-ROM drive

Step 2 An install screen opens.

Step 3 Click *Install Software* and follow the onscreen instructions.

Updating from the CATC Website

Step 1 Open a web browser and navigate to www.catc.com.

Step 2 Find the latest released software version on the CATC website under **Support** at the link shown at the top of the page.

If you are running the latest version of the software, no further action is needed.

If you are **not** running the latest version.

Step 3 Download the software from the CATC website.

Step 4 If downloading from the web, unzip the files into your choice of directory.

Step 5 Click **Start**, then **Run**, and browse to where you unzipped the files.

Step 6 Select the program named **Setup** and click **Open**.

Step 7 Click **OK** to run the Setup and begin the installation.

Step 8 Follow the on-screen instructions to complete the installation.

Step 9 Read the Readme file for important information on changes in the release.

3.5 License Information

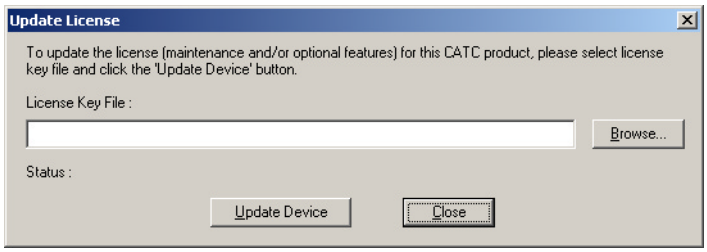
Licensing information for Merlin II can be viewed by selecting **Display Information** from the **Help** menu. The License window provides maintenance expiration and features data for Merlin II.

Updating the Software License

A License key is necessary to enable software maintenance.

A license is granted with the purchase of an analyzer. Thereafter, you must renew your license if you wish to continue receiving support. You obtain a new License Key from CATC. Once the License Key is obtained, follow these steps to install it:

Step 1 From the **Help** menu, select **Update License**. The Update License dialog displays.


Update License
To update the license (maintenance and/or optional features) for this CATC product, please select license key file and click the 'Update Device' button.
License Key File :
Browse...
Status :
Update Device
Close

Step 2 Enter the path and filename for the License key or use the Browse button to navigate to the directory that contains the License Key.

Step 3 Select the *.lic file, and then click **Update Device**.

4. Software Overview

4.1 The Main Display Windows

While some of the analyzer's Main Display window options are familiar, many contain options specific to the analyzer program.

Table 1: Main Display Pull-Down Windows

Menu	Function
File	
Open…	Opens a file
Close	Closes the current file
Save As…	Saves all or a specified range of packets from the current file with a specified name
Re-apply Encryption Settings ...	If a trace has been recorded with the wrong encryption settings, you can enter the correct ones via the Device List, then run **File> Re-apply Encryption Settings ...** This command will open a Save As dialog box for creating a new trace file using the new settings.
Print…	Prints part or all of the current traffic data file
Print Preview	Produces an on-screen preview before printing
Print Setup…	Sets up your current or new printer
Edit Comment…	Creates or edits the Trace file comment field
Import » Device List...	Imports Device List file of previously identified devices & addresses.
Export » Packets to Text (Packet View Format)	Saves all or part of a trace to a text file
Export » Packets to CSV Text	Saves all or part of a trace to a Comma Separated Values (CSV) file suitable for viewing in a spreadsheet application
Export>>Audio Streams	Saves audio data into a file. Presents options for setting the Audio Source format, Output File format, Stream Direction, and Output Sampling
Last File	Lists the last files that were opened
Exit	Exits the Merlin II program
Setup	
Display Options	Provides the control of various display options such as color, formats, and filters.
Recording Options	Opens a dialog box with checkboxes and drop-down menus for setting up a recording.
Recording Wizard	Starts a sequence of interactive dialog boxes that configures Merlin II for a recording. This utility provides an alternative to the Recording Options dialog box.
Update BE/FW	Allows the operator to update the BusEngine and Firmware.

Menu	Function
Connectors ...	Opens a dialog box for the output connector on the back of the analyzer. There are two options: **Default Configuration** - Causes the analyzer to output a low voltage output signal for use by another device such as an oscilloscope. See "External Input Signals" on page 88 for further explanation. **Output Radio Data** - Causes the analyzer to output radio signals through External Output connectors. If you place your mouse pointer over the Output Radio Data option, a tool tip will provide a detailed explanation of this option's function.
Record	
Start	Causes the Analyzer to begin recording Bluetooth activity.
Stop	Causes the Analyzer to stop recording.
Recording Mode	Presents a drop-down menu with options for setting the analyzer's recording mode: ***Piconet Recording Mode*** -- Causes Merlin II to monitor and record piconet traffic. Merlin II records the traffic data as specified in the Recording Options, then uploads the data as a Trace file when the recording is complete. ***Inquiry Recording Mode*** -- Causes Merlin II to perform an inquiry to detect and record Bluetooth devices within range. After completing the recording, Merlin II uploads the trace to the PC and saves it as a Trace file.
BT Neighborhood Inquiry	Displays Bluetooth Address & clock frequency for devices in range. The expected Bluetooth clock frequency is 3200 Hz +/- 250 ppm.
Report	
File Information	Details such information about the recording as number of packets and triggering setup.
Error Summary	Displays an error summary of the current trace file & allows you to go to a specific packet, and save the error file to a uniquely named file.
Timing Calculation	Starts the calculator dialog for calculating various timing and bandwidth parameters in the recording file.
Traffic Summary	Details the number and type of packets were transferred during the recording, as well as message-level statistics.
Search	
Go to trigger	Positions the display to show the first packet that follows the trigger event.
Go to Packet/Message/ Protocol ...	Positions the display to the indicated packet, LMP/L2CAP message, or Protocol Message (RFCOMM, TCS, or SDP protocols).
Go to Marker »	Positions the display to a previously marked packet.
Go to »	Enables quick searching for specific events using a cascade of pop-up windows.
Find	Allows complex searches.
Find Next	Repeats the previous Find operation. Can also use F3 to find next.
Search Direction	Allows you to specify a forward or backward search of a trace file.

Menu	Function
View	
Toolbars	Presents a sub-menu with options for displaying/hiding the toolbars and an option called Customize which allows the menus and toolbars to be customized or reset to factory default.
Status Bar	Switches display of the Status Bar on or off.
Unhide Cells >	Presents a menu of currently hidden cells. Allows you to unhides any cells that were hidden through the Display Options dialog box (View > Display Options > Color/Format/Hiding)
Zoom In	Increases the size of the displayed elements.
Zoom Out	Decreases the size of the displayed elements.
Wrap	Allows the display to wrap.
Device List	Displays a list of discovered Bluetooth devices and allows you to add and delete devices and security settings by selecting the device, pressing the security button, and modifying the settings.
Real-time Statistics	Opens a dialog box with a graphical summary of the traffic currently being recorded by the Analyzer. Real-time monitoring allows continuous monitoring and displaying of traffic and related statistical dada in a piconet. This processed data is displayed in a set of configurable graphs.
Decoding Assignments	Lists current L2CAP decoding assignments.
L2CAP Connections	Lists current L2CAP connections.
RFCOMM Channel Assignments	Lists current RFCOMM assignments.
Levels	Presents a menu of display levels. This menu replicates the Decode/Display buttons in the toolbar such as Packets, L2CAP, TCS etc.)
Profiles	Presents a menu of profiles. Selecting a profile will cause the analyzer to decode the protocols appropriate for the selected profile.
Window	
New Window	Switches display of the Tool Bar on or off.
Cascade	Displays all open windows in an overlapping arrangement.
Tile	Arranges multiple trace windows as a series of strips across the main display area or as a series of side-by-side tiles.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Windows	Displays a list of open windows.

Help	
Online Help	Displays Help topic associated with current Merlin II window.
Help Topics...	Displays online help.
Update License...	Opens a dialog box for entering license key information for the analyzer.
Display License Information...	Displays current license information for the analyzer.
About Merlin II...	Displays version information about Merlin II.

4.2 Toolbar

There are five toolbars in the Merlin II user interface toolbar. The Toolbar buttons provide access to frequently-used program functions. Tool tips describe icon functionality as the mouse arrow is moved over an item.

You display or hide toolbars by selecting **View** > **Toolbars** from the menu. The sub-menu lists four toolbar names: **Standard**, **Frequently Used**, **Analysis**, **View Level, and Profiles**.

Standard Toolbar

Open file

Save As

Print Preview

Print…

Setup Record Options - presents options for setting up a recording.

Setup Display Options - presents options for formatting the display.

Setup Display Options - presents options for formatting the display.

Start Recording - starts a recording. The down arrow gives you options for starting different types of recordings: recording piconet, inquiry recording, BTTrainer recording, or IUT:HCI recording.

Stop Recording

Manually trigger the analyzer. Causes the analyzer to stop recording after the post-trigger buffer is filled.

Snapshot. Causes the analyzer to extract and display a portion of the current recording into a new temporary window.

Insert marker. Inserts a marker into the trace.

Bluetooth Neighborhood. Performs an inquiry and then lists the local devices that it discovered.

"Frequently Used" Toolbar

Zoom In

Zoom Out

Wrap

Show/Hide Channel 1 Traffic

Show/Hide Channel 2 Traffic

Show/Hide Duplicated Traffic

Show/Hide Frequency Hops

Show/Hide Nulls & Polls

Show/Hide ID Packets

Show/Hide Voice (SCO) Packets

Show/Hide devices. Click the down arrow to open a menu with device addresses. Selecting a device address hides the device in the trace. This button duplicates the functionality of the Hide Device options in the Display Options dialog box.

Show/Hide Unassociated Traffic

Show/Hide HCI Traffic

Complex Find

Find Next

Analysis Toolbar

Display Real time log

Display device list

File Information Report

Error Summary

Timing Calculations

Traffic Summary

Display Bus Utilization graph

Display Real-Time Statistics

View Level Toolbar

View Packet Level (Baseband)

View HCI Traffic

View/Hide LMP Message Level

View/Hide L2CAP Message Level

View/Hide SDP Message Protocol Level

View/Hide SDP Transaction Protocol Level

View/Hide TCS Protocol Level

View/Hide RFCOMM Protocol Level

View/Hide OBEX Protocol Level

View/Hide OBEX Protocol Transaction Communications Level

View AT Commands Protocol Level

View/Hide HDLC Protocol

View/Hide PPP

View/Hide HCRP

View/Hide AVCTP

View/Hide AVDTP

View/Hide BNEP Protocol

View HID Protocol Layer

View IP Protocol Layer

View TCP Protocol Layer

View UDP Protocol Layer

View Profiles Toolbar

Profile buttons decode the protocols associated with a particular profile. When you press a profile button, the Merlin II software will automatically select for you the protocol buttons associated with that profile such as RFCOMM and OBEX.

Note: This toolbar is hidden on initial activation of the application. To display this toolbar, select **View** > **Toolbars** > **Profiles** from the menu.

Decodes protocols for the GAP profile.

Decodes protocols for the SDAP profile.

Decodes protocols for the CIP profile.

Decodes protocols for the GAVDP profile.

Decodes protocols for the CTP profile.

Decodes protocols for the INT profile.

Decodes protocols for the SPP profile.

Decodes protocols for the HP profile.

Decodes protocols for the DUP profile.

Decodes protocols for the FAX profile.

Decodes protocols for the LAN profile.

Decodes protocols for the SIM profile.

Decodes protocols for the OBEX profile.

Decodes protocols for the OPP profile.

Decodes protocols for the FTP profile.

Decodes protocols for the SYNC profile.

Decodes protocols for the BIP profile.

Decodes protocols for the A2DP profile.

Decodes protocols for the BIP profile.

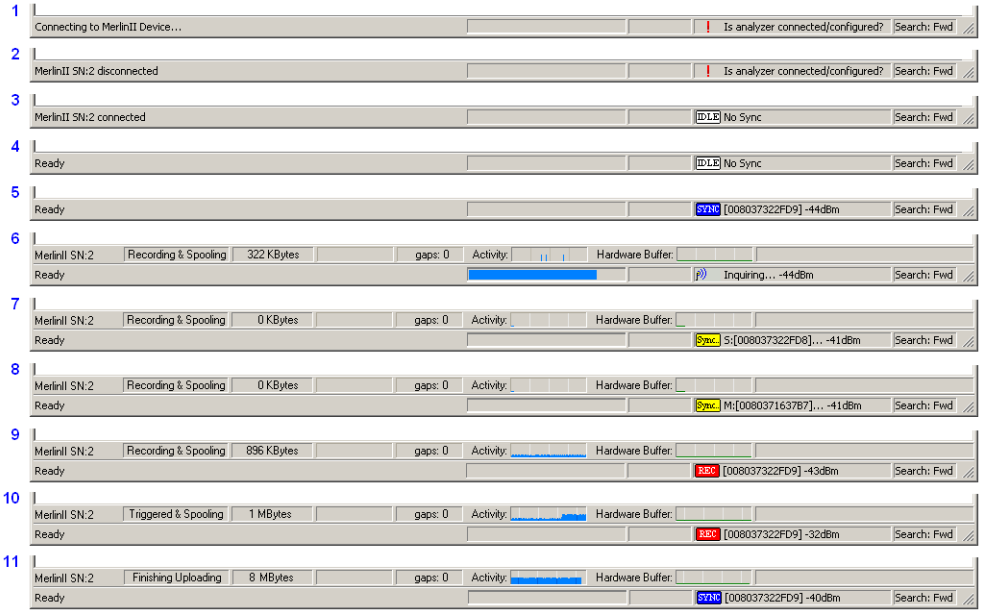
Decodes protocols for the BIP profile.

4.3 Status Bar

The Status Bar is located at the bottom of the main display window. Depending on the current activity, the bar can be divided into as many as four segments. The figure below demonstrates the various displays in the status bar.

Recording Progress

When you begin recording, the left-most segment of the Status Bar displays a Recording Progress Indicator. The following figure displays the various indications of the status bar:



Status Bar Position Definitions:

The following numbered definitions correspond to the number labels on the above status bars.

1 Analyzer is connecting to the host machine.

2 Analyzer was disconnected from the host machine.

3 Analyzer is connected to the host machine.

4 Analyzer is connected to the host machine and is an idle mode.

5 Analyzer is synchronized to a piconet with master device that has BD_Address 008037322FD9.

6 Analyzer is performing an inquiry (BT Neighborhood).

7 Analyzer is in the process of synchronizing to a piconet with **slave** device that has BD_Address 008037322FD8. The analyzer is set to use the 'Page Sync & Record' synchronization method, with master address set to 'any.

8 Analyzer is in the process of synchronizing to a piconet with **master** device that has BD_Address 008037322FD9. No trigger connection received yet.

9 Analyzer is in the process of synchronizing to a piconet with master device that has BD_Address 0080371637B7. The analyzer is set to use either of the synchronization methods (if the 'Page Sync & Record' synchronization method is used the master address is set to 0080371637B7).

10 Analyzer is recording the traffic of the piconet with master device that has BD_Address 008037322FD9. The trigger condition was received.

11 Analyzer has finished uploading the recorded traffic.

As recording progresses, the Progress Indicator changes to reflect the recording progress graphically:

- In the Progress Indicator, a black vertical line illustrates the location of the Trigger Position you selected in Recording Options.
  - Pre-Trigger progress is displayed in the field to the left of the Trigger Position in the before-Trigger color specified in the Display Options.
  - When the Trigger Position is reached, the progress indicator wiggles as it waits for the trigger.
  - After the trigger occurs, the field to the right of the Trigger Position fills in the post-Trigger color specified in the Display Options.
  - When recording is complete, the upper half of the progress indicator fills in white, indicating the progress of the data upload to the host computer.

You should be aware of two exceptional conditions:

- If a Trigger Event occurs during the before-Trigger recording, the before-Trigger color changes to the after-Trigger color to indicate that not all the expected data was recorded pre-Trigger.
- When you click **Stop** before or after a Trigger Event, the Progress Bar adjusts accordingly to begin uploading the most recently recorded data.

The Progress Bar fills with color in proportion to the specified size and actual rate at which the hardware is writing and reading the recording memory. However, the Progress Indicator is normalized to fill the space within the Status Bar.

Recording Status

During recording activity, the current Recording Status is temporarily displayed in the next segment. When you activate the **Record** function, this segment flashes one of the following messages (depending on the selected Recording Options):

- Trigger?
- Triggered!
- Recording & Spooling
- Uploading

After recording stops,

- The flashing message changes to **Uploading data–*x*% done** (**x%** indicates the percentage completion of the data uploading process).
- The traffic data is copied to disk (overwriting any previous version of this file) using the default file name **data.tfb** or a new name specified in the Recording options.

To abort the upload process,

- Press **Esc** on your keyboard

  OR

  Again click in the Tool Bar.

  You are prompted to choose whether to keep the partially uploaded data or to throw it away.

When the data is saved, the Recorded Data file appears in the main display window and the Recording Status window is cleared.

- If the recording resulted from a Trigger Event, the first packet following the Trigger (or the packet that caused the Trigger) is initially positioned second from the top of the display.
- If the recording did not result from a Trigger Event, the display begins with the first packet in the traffic file.

Analyzer Status

The third segment in the status bar displays analyzer status. The status will display one of the following:

No Sync - the system is not synced to any piconet

Inquiring... - The system is performing an Bluetooth Inquiry

Inquiring (infinite) ...- The timeout is set to 0.

Sync [XXX]... - The system is attempting to synchronize to a piconet where the device with BD_Address XXX is the master.

Sync [XXX] - The system is synchronized to a piconet where the device with BD_Address XXX is the master.

Rec [XXX] - System is recording the Bluetooth traffic of the piconet where the device with BD_Address XXX is the master.

Received Signal Strength Indication (RSSI) - After the analyzer has synchronized to the Bluetooth piconet under observation, an RSSI measurement of the master's transmission will appear in the status bar along side of the Master's address and the Sync/Rec status. The signal strength readings will display as a value in the range of -85 dBm to -17 dBm. When performing an inquiry, the status bar displays the RSSI measurement of the responding devices.

The average RSSI measurement per device can be viewed in the Real Time Statistics window. The RSSI measurement per packet can be seen in the trace itself by expanding the **Freq** cells.

Search Status

The rightmost segment displays the current search direction: **Fwd** (forward) or **Bwd** (backward).

4.4 Zooming In and Out

The Zoom In and Zoom Out buttons allow the trace to be displayed in a larger or smaller format.

Zoom In

Zoom In increases the size of the displayed elements, allowing fewer (but larger) packet fields per screen.

- Click on the Tool Bar.

Zoom Out

Zoom Out decreases the size of the displayed elements, allowing more (but smaller) packet fields per screen.

- Click on the Tool Bar.

4.5 Tool Tips

Throughout the application, tool tips provide useful information.

To display a tool tip, position the mouse pointer over an item. The tool tip displays in a short moment if present. Tool tips can also be found over the Tool Bar and in areas of the packet view screen.

4.6 Merlin II Analyzer Keyboard Shortcuts

Several frequently-used operations are bound to keyboard shortcuts.

Table 2: Keyboard Shortcuts

Key Combination	Operation	Key Combination	Operation
Ctrl+O	Open file	Ctrl+P	Print...
Ctrl+Home	Jump to First packet	Ctrl+End	Jump to Last packet
Ctrl+F	Search Forward	Ctrl+B	Search Backward
F3	Find Next	Ctrl+L	Search for Loss of Sync
Shift+I	Goto ID packet	Shift+R	Goto Freq Hop packet
Shift+P	Goto Poll packet	Shift+N	Goto Null packet
Shift+M	Goto DM1 packet	Shift+F	Goto FHS packet
Shift+1	Goto HV1 packet	Shift+H	Goto DH1 packet
Shift+3	Goto HV3 packet	Shift+2	Goto HV2 packet
Shift+A	Goto AUX1 packet	Shift+V	Goto DV packet
Shift+5	Goto DH3 packet	Shift+4	Goto DM3 packet
Shift+7	Goto DH3 packet	Shift+6	Goto DM5 packet
Shift+S	Search for Soft Error	Shift+E	Search Error

5. Recording Wizard

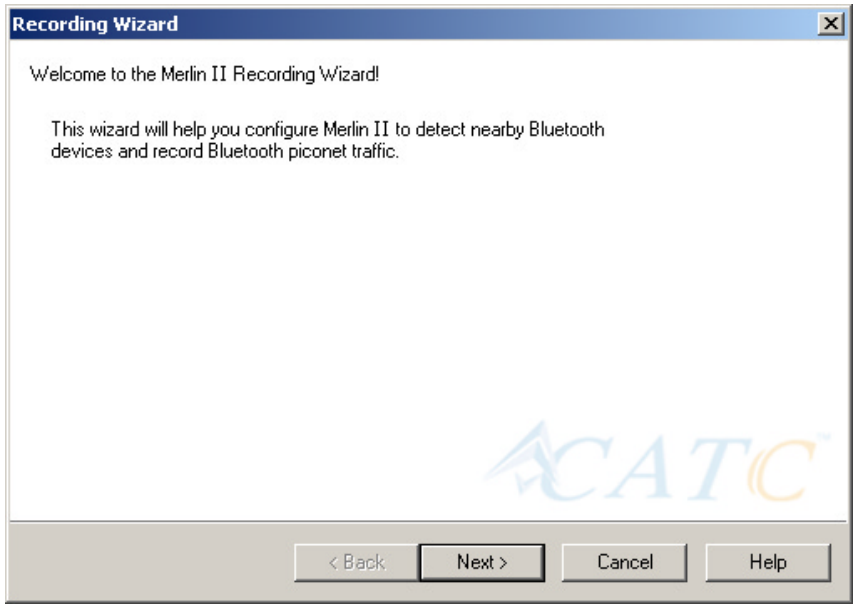
Recording Wizard is an interactive utility that presents a series of user-friendly dialog boxes for setting up a recording session. Recording Wizard serves as an alternative method of configuring the Recording Options dialog box. When you are finished using the Wizard, you can view your settings in the Recording Options window. By providing data to the prompts in the Wizard's dialog boxes, you configure Merlin II for a recording session.

Starting Recording Wizard

To start the **Recording Wizard**,

- Click on the Tool Bar or select **Recording Wizard** under **Setup** on the Menu Bar.

You see the **Recording Options** window:

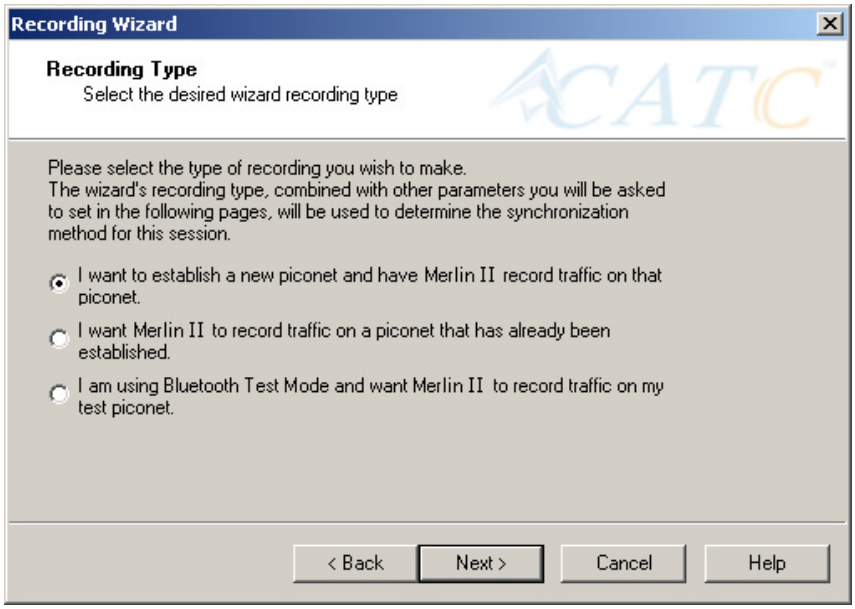

Recording Wizard
Welcome to the Merlin II Recording Wizard!
This wizard will help you configure Merlin II to detect nearby Bluetooth devices and record Bluetooth piconet traffic.
< Back
Next >
Cancel
Help

The **Recording Options** window has three buttons marked **Next**, **Back**, and **Cancel** that allow you to move forward or backward through the wizard or to cancel the wizard.

To begin advancing through the wizard,

- Click **Next** to see the options for the three types of recordings that the Recording Wizard can make.

The Wizard advances to the next screen which presents three options:


Recording Wizard
Recording Type
Select the desired wizard recording type
Please select the type of recording you wish to make.
The wizard's recording type, combined with other parameters you will be asked to set in the following pages, will be used to determine the synchronization method for this session.
I want to establish a new piconet and have Merlin II record traffic on that piconet.
I want Merlin II to record traffic on a piconet that has already been established.
I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.
< Back
Next >
Cancel
Help

- **I want to establish a new piconet and have Merlin II record traffic on that piconet.**

  This option causes Merlin II to perform an Inquiry so it can discover local devices and then establish a new piconet and record the piconet traffic.

- **I want Merlin II to record traffic on a piconet that has already been established.**

  This option lets Merlin II record traffic from an already established piconet.

- **I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.**

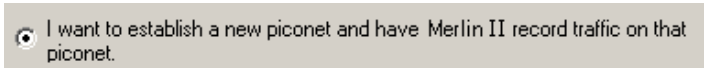
  This option lets Merlin II create either a single frequency range recording of a range that you specify or create a recording of a limited hop frequency range consisting of 5 frequency hops.

5.1 Recording a Traffic on a New Piconet

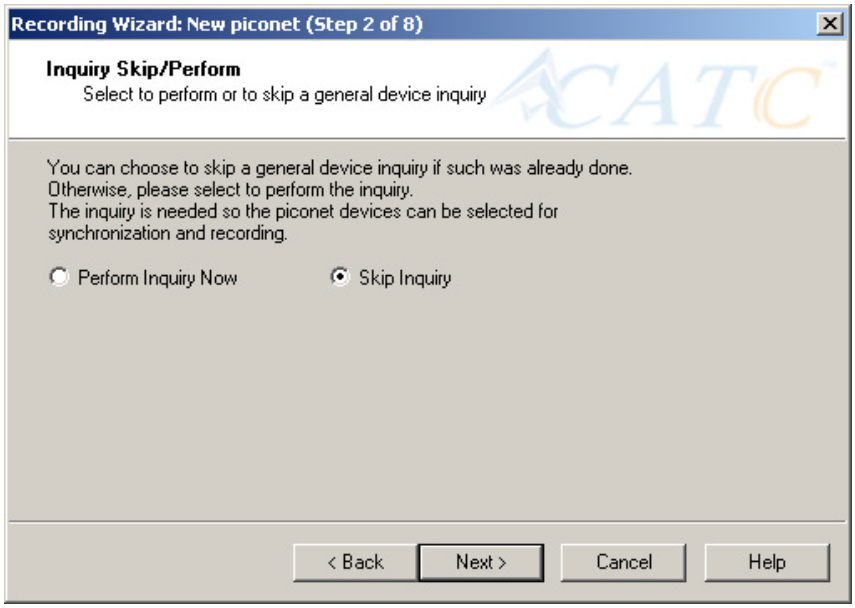
The **New Piconet** option shown in the previous screen presents users with the means of recording the traffic from a new piconet. This option will cause a sequence of screens to prompt you for information such as the piconet Master address.

The following steps shows you how to configure Merlin II to record a new piconet.

Step 1 From the screen shown in the previous screenshot, select the first option: **I want to establish a new piconet and have Merlin II record traffic on that piconet**, then press **Next**.



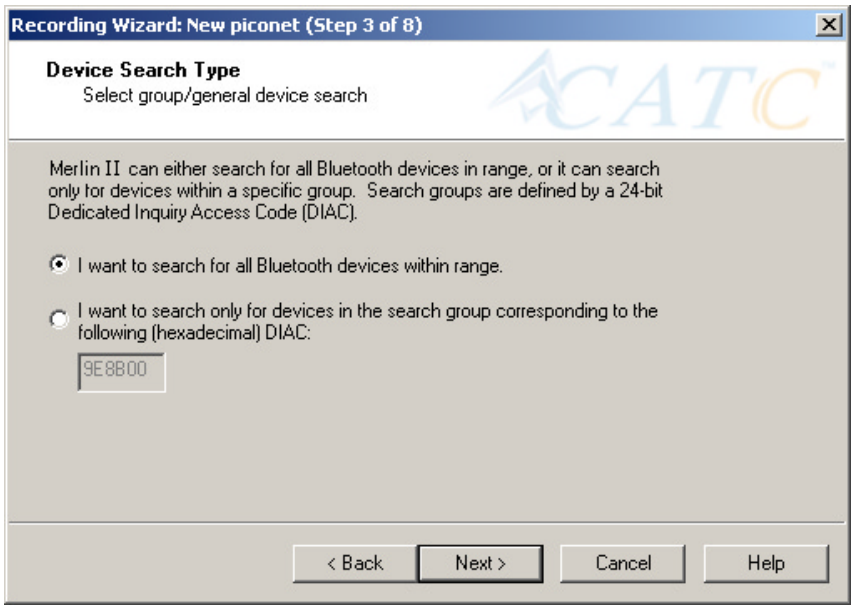
The following screen displays.


Recording Wizard: New piconet (Step 2 of 8)
Inquiry Skip/Perform
Select to perform or to skip a general device inquiry
You can choose to skip a general device inquiry if such was already done.
Otherwise, please select to perform the inquiry.
The inquiry is needed so the piconet devices can be selected for synchronization and recording.
Perform Inquiry Now
Skip Inquiry
< Back
Next >
Cancel
Help

Step 2 Select **Perform Inquiry Now**, then press **Next**.

Selecting **Perform Inquiry Now** will cause Merlin II to perform a General Inquiry and collect addresses and other details about local Bluetooth devices. If you already have address information for your Bluetooth devices you can choose **Skip Inquiry**. Choosing **Skip Inquiry** will cause the Recording Wizard to advance to Step 6. If you are not sure what option to select, choose **Perform Inquiry Now**.

The following screen will display.


Recording Wizard: New piconet (Step 3 of 8)
Device Search Type
Select group/general device search
Merlin II can either search for all Bluetooth devices in range, or it can search only for devices within a specific group. Search groups are defined by a 24-bit Dedicated Inquiry Access Code (DIAC).
I want to search for all Bluetooth devices within range.
I want to search only for devices in the search group corresponding to the following (hexadecimal) DIAC:
9E8B00
< Back
Next >
Cancel
Help

You will see two options:

- **I want to search for all Bluetooth devices within range**

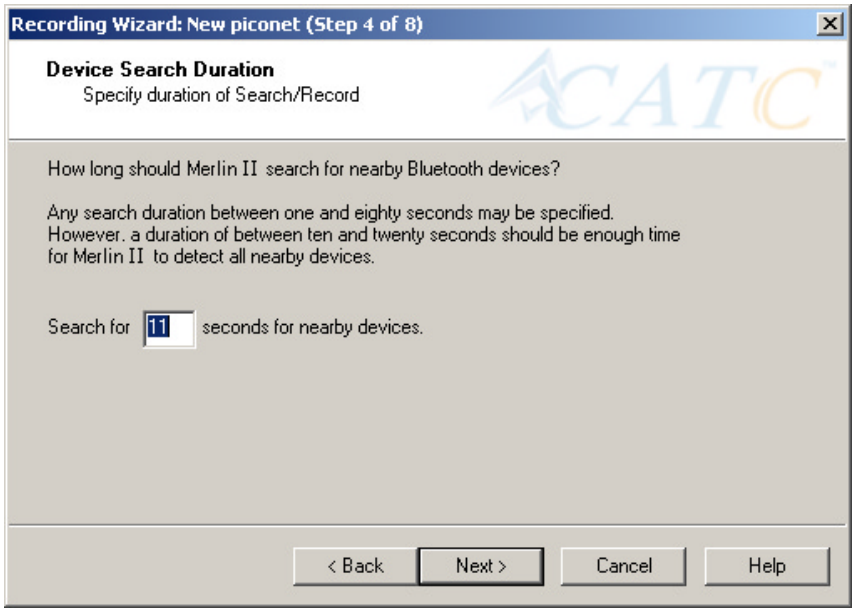
  This option will cause Merlin II to search for all Bluetooth devices that are in range and ready to transmit and receive data (i.e., in *Inquiry Scan Mode*)

- **I want to search only for devices corresponding to the following (hexadecimal) DIAC:**

  This option will cause Merlin II to search for the class of devices that you specify in the DIAC text box. DIAC stands for *Device Inquiry Access Code*. Values are entered in hexadecimal format. You can get DIAC values from the Bluetooth Specification.

Step 3 Select the first option: **I want to search for all Bluetooth devices**

within range, then press **Next**. The following screen will display.


Recording Wizard: New piconet (Step 4 of 8)
Device Search Duration
Specify duration of Search/Record
How long should Merlin II search for nearby Bluetooth devices?
Any search duration between one and eighty seconds may be specified.
However. a duration of between ten and twenty seconds should be enough time
for Merlin II to detect all nearby devices.
Search for 11 seconds for nearby devices.
< Back
Next >
Cancel
Help

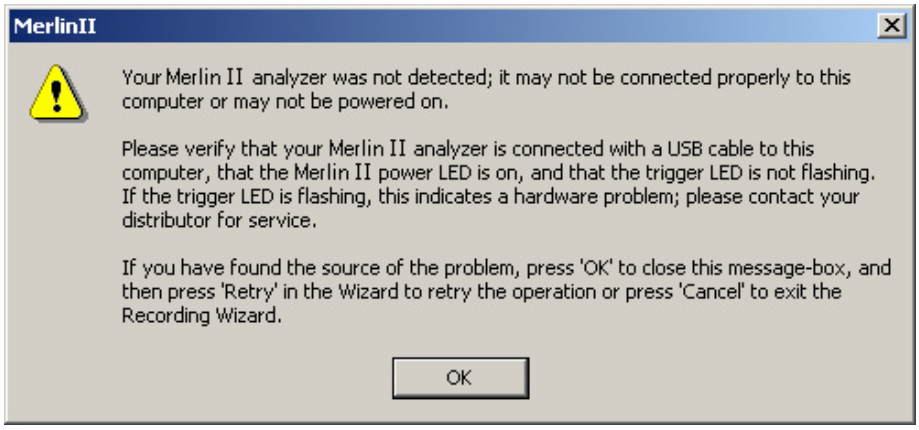
You will see two options:

Step 4 In the text box, enter the length of time you want Merlin II to search for nearby devices.

The default value is **11**. If you do not sure what time value to enter, use the default value.

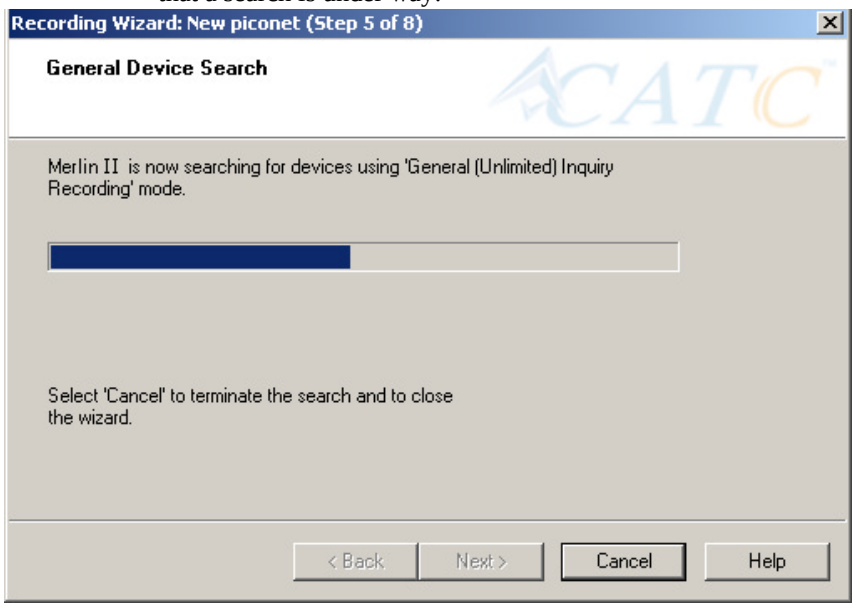
Step 5 Press **Next**.

Before the Inquiry, Merlin II tests the hardware connection. In the case of failure, the following screen will display.

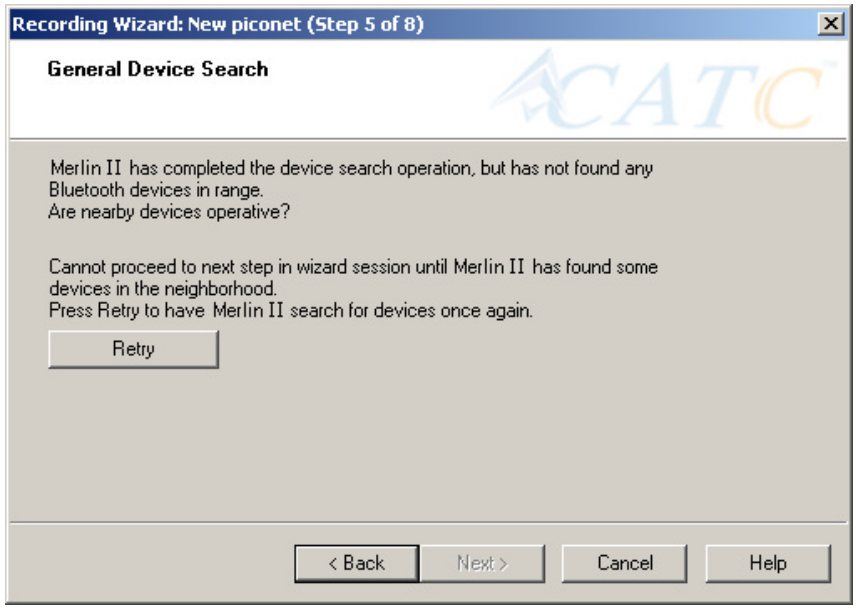

MerlinII
Your Merlin II analyzer was not detected; it may not be connected properly to this computer or may not be powered on.
Please verify that your Merlin II analyzer is connected with a USB cable to this computer, that the Merlin II power LED is on, and that the trigger LED is not flashing. If the trigger LED is flashing, this indicates a hardware problem; please contact your distributor for service.
If you have found the source of the problem, press 'OK' to close this message-box, and then press 'Retry' in the Wizard to retry the operation or press 'Cancel' to exit the Recording Wizard.
OK

Clicking **OK** will close the message box.

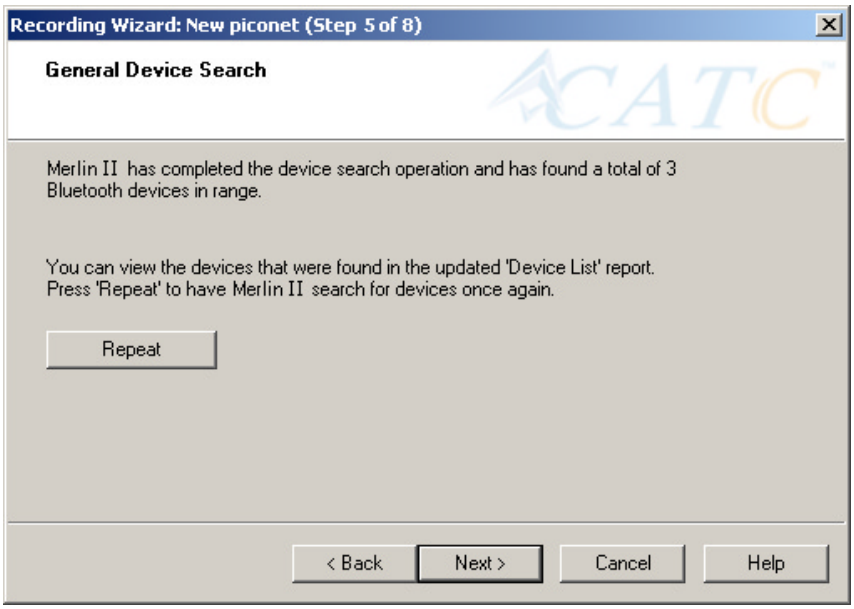
If Merlin II passes the hardware test, it will search for devices. The Recording Wizard will display a progress bar and a message telling you that a search is under way:


Recording Wizard: New piconet (Step 5 of 8)
General Device Search
Merlin II is now searching for devices using 'General (Unlimited) Inquiry Recording' mode.
Select 'Cancel' to terminate the search and to close the wizard.
< Back
Next >
Cancel
Help

If no device is found, the Recording Wizard will display the following screen:

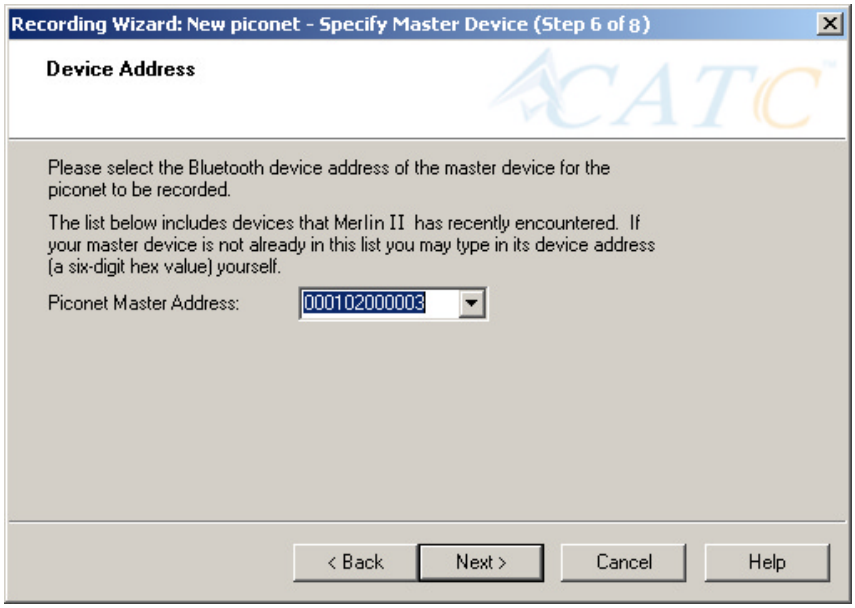

Recording Wizard: New piconet (Step 5 of 8)
General Device Search
Merlin II has completed the device search operation, but has not found any Bluetooth devices in range.
Are nearby devices operative?
Cannot proceed to next step in wizard session until Merlin II has found some devices in the neighborhood.
Press Retry to have Merlin II search for devices once again.
Retry
< Back
Next >
Cancel
Help

If devices found, the Recording Wizard will display the following screen:


Recording Wizard: New piconet (Step 5 of 8)
General Device Search
Merlin II has completed the device search operation and has found a total of 3 Bluetooth devices in range.
You can view the devices that were found in the updated 'Device List' report. Press 'Repeat' to have Merlin II search for devices once again.
Repeat
< Back
Next >
Cancel
Help

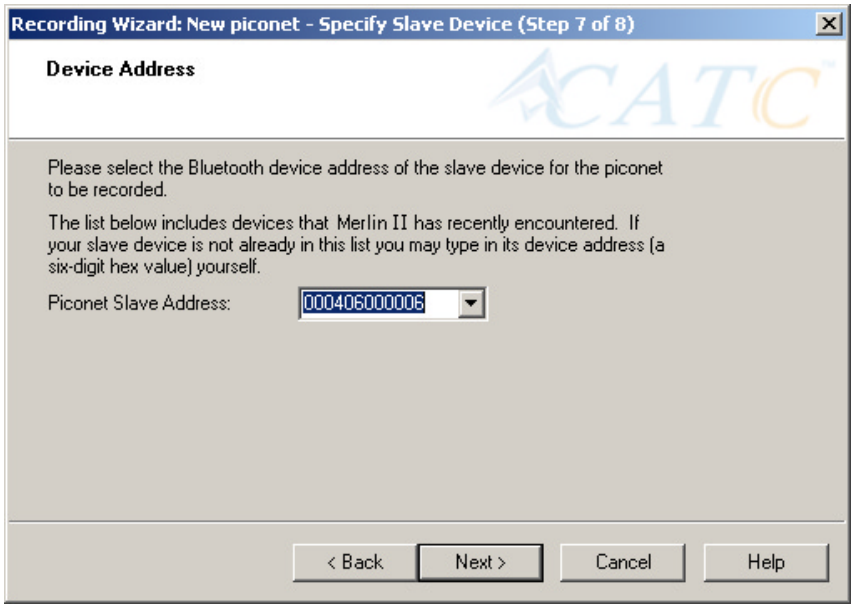
Step 6 Press **Next**.

The following window will display:


Recording Wizard: New piconet - Specify Master Device (Step 6 of 8)
Device Address
Please select the Bluetooth device address of the master device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Piconet Master Address:
000102000003
< Back
Next >
Cancel
Help

Step 7 Select from the drop-down menu the hexadecimal address for your Master device. If you do not see your device's address, you may type it into the text box yourself.

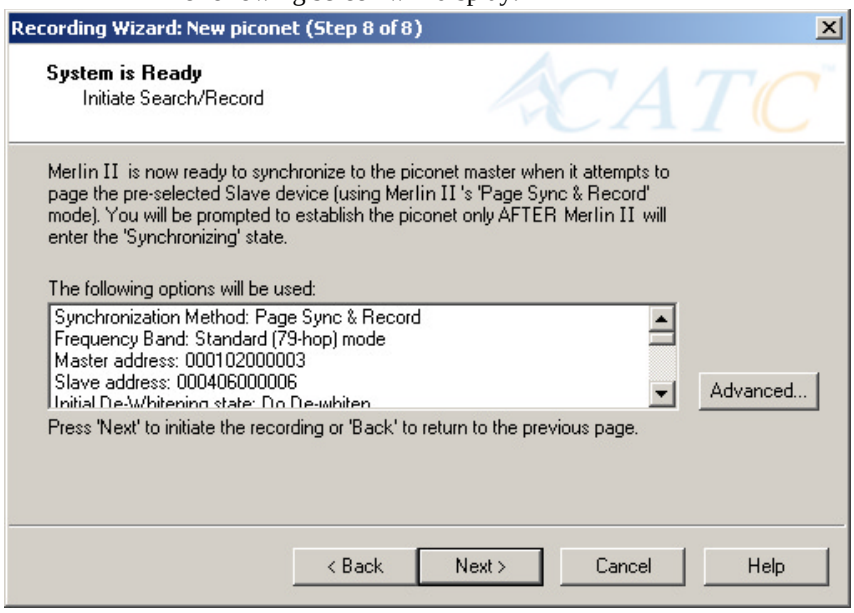
The following window will display:


Recording Wizard: New piconet - Specify Slave Device (Step 7 of 8)
Device Address
Please select the Bluetooth device address of the slave device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your slave device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Piconet Slave Address:
000406000006
< Back
Next >
Cancel
Help

Step 8 Select from the drop-down menu the hexadecimal address for your slave device into the box labeled **Piconet Slave Address**. If you do not see your slave's address, you can type it into the box.

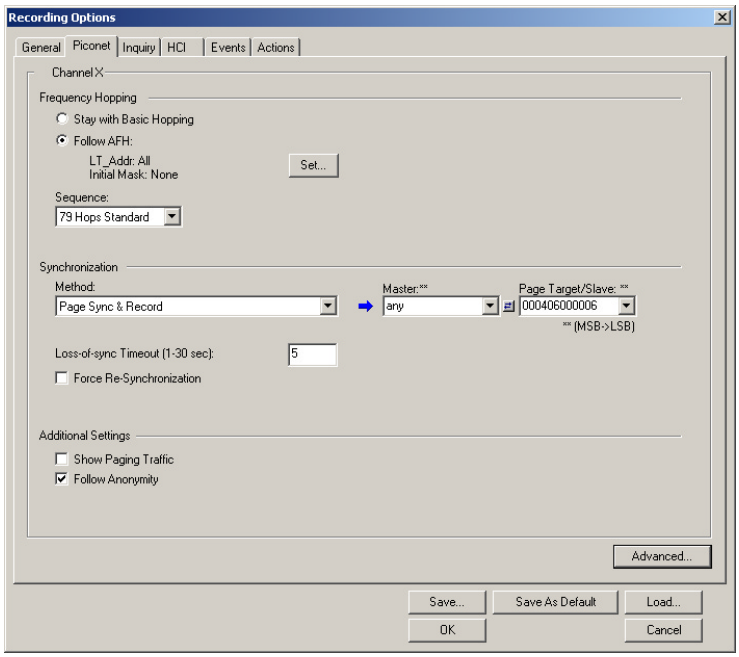
Step 9 Press **Next**.

The following screen will display.


Recording Wizard: New piconet (Step 8 of 8)
System is Ready
Initiate Search/Record
Merlin II is now ready to synchronize to the piconet master when it attempts to page the pre-selected Slave device (using Merlin II 's 'Page Sync & Record' mode). You will be prompted to establish the piconet only AFTER Merlin II will enter the 'Synchronizing' state.
The following options will be used:
Synchronization Method: Page Sync & Record
Frequency Band: Standard (79-hop) mode
Master address: 000102000003
Slave address: 000406000006
Advanced...
Press 'Next' to initiate the recording or 'Back' to return to the previous page.
< Back
Next >
Cancel
Help

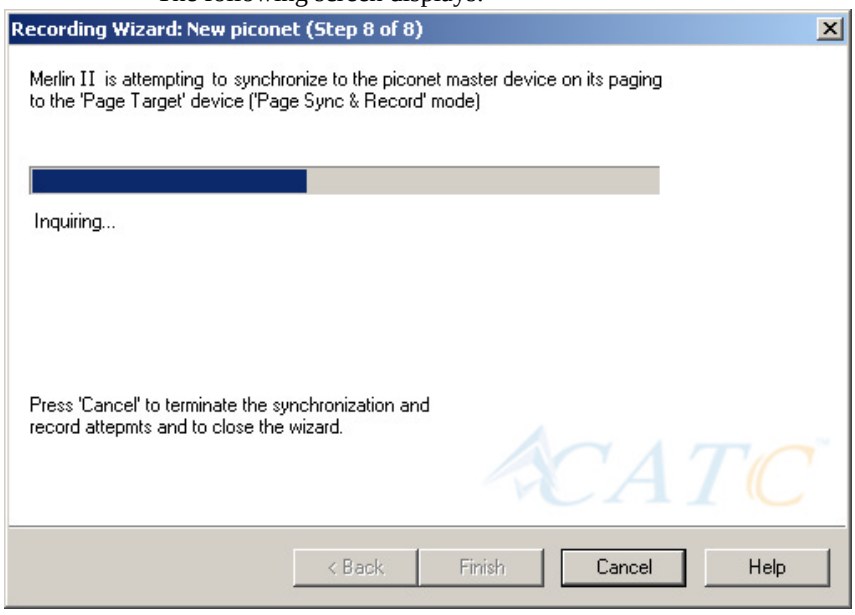
This screen displays the settings you selected.

The **Advanced** button on the right will open the Recording Options dialog box shown below. This screen will show the settings you selected through the Recording Wizard have been applied to the Recording Options dialog.



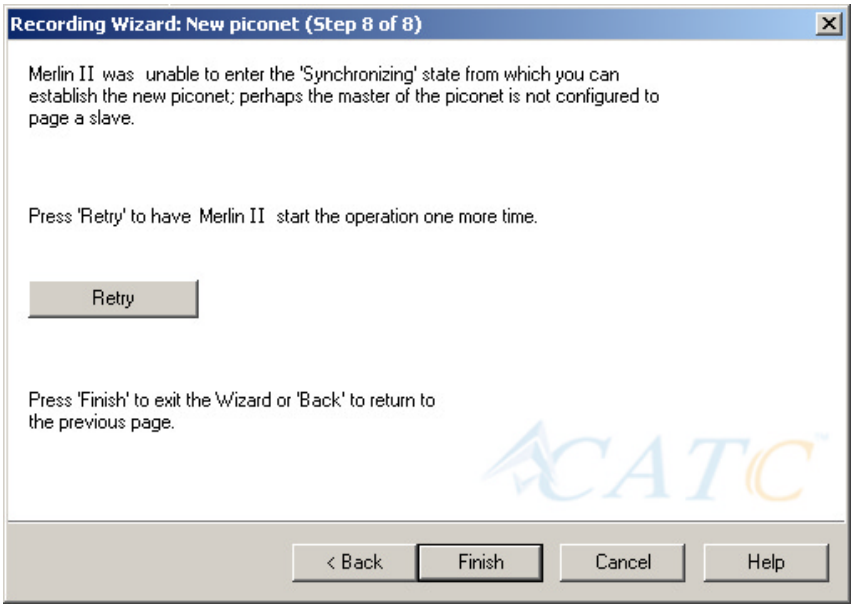
Step 10 Press **Next** to advance the Recording Wizard to the next screen.

The following screen displays:

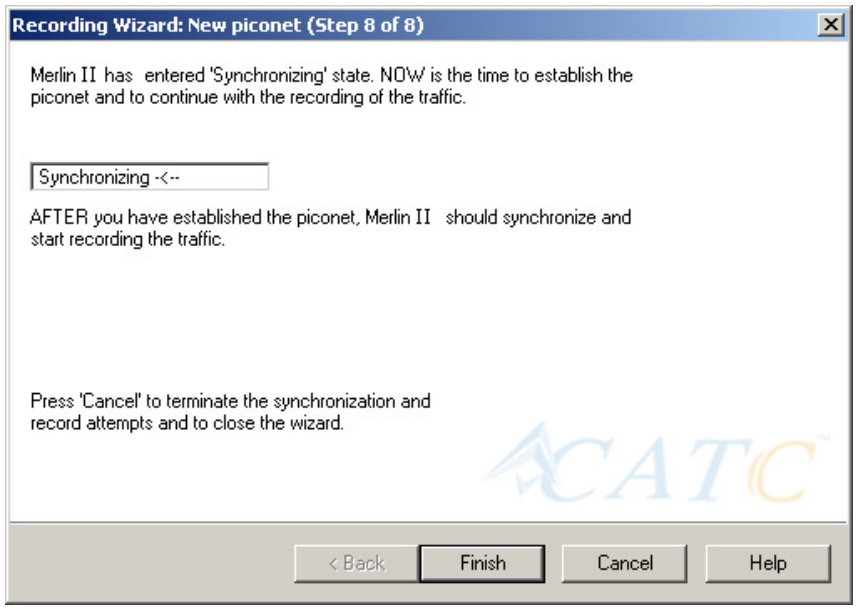

Recording Wizard: New piconet (Step 8 of 8)
Merlin II is attempting to synchronize to the piconet master device on its paging to the 'Page Target' device ('Page Sync & Record' mode)
Inquiring...
Press 'Cancel' to terminate the synchronization and record attepmts and to close the wizard.
< Back
Finish
Cancel
Help

Merlin II pages the Master and if specified in Step 8, the Slave devices.

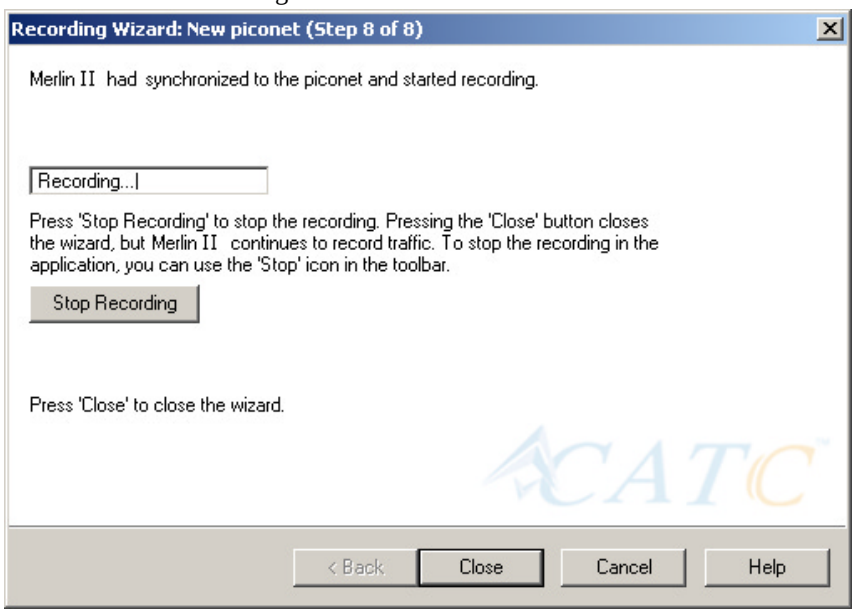
If Merlin II is unable to complete its pages, the following screen will display:


Recording Wizard: New piconet (Step 8 of 8)
Merlin II was unable to enter the 'Synchronizing' state from which you can establish the new piconet; perhaps the master of the piconet is not configured to page a slave.
Press 'Retry' to have Merlin II start the operation one more time.
Retry
Press 'Finish' to exit the Wizard or 'Back' to return to the previous page.
< Back
Finish
Cancel
Help

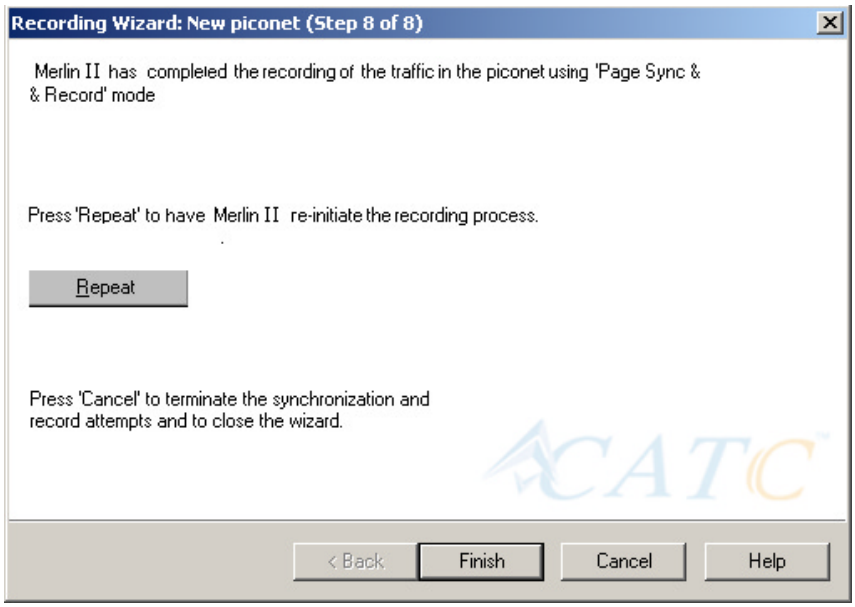
If Merlin II is able to complete its pages, it will enter into a synchronizing state and then wait for you to create the piconet. During this waiting period, Merlin II will display the following screen:


Recording Wizard: New piconet (Step 8 of 8)
Merlin II has entered 'Synchronizing' state. NOW is the time to establish the piconet and to continue with the recording of the traffic.
Synchronizing -<--
AFTER you have established the piconet, Merlin II should synchronize and start recording the traffic.
Press 'Cancel' to terminate the synchronization and record attempts and to close the wizard.
< Back
Finish
Cancel
Help

Once you have created the piconet, Merlin II will synchronize to the piconet and begin recording. During the recording, Merlin II will display the following screen:


Recording Wizard: New piconet (Step 8 of 8)
Merlin II had synchronized to the piconet and started recording.
Recording...
Press 'Stop Recording' to stop the recording. Pressing the 'Close' button closes the wizard, but Merlin II continues to record traffic. To stop the recording in the application, you can use the 'Stop' icon in the toolbar.
Stop Recording
Press 'Close' to close the wizard.
< Back
Close
Cancel
Help

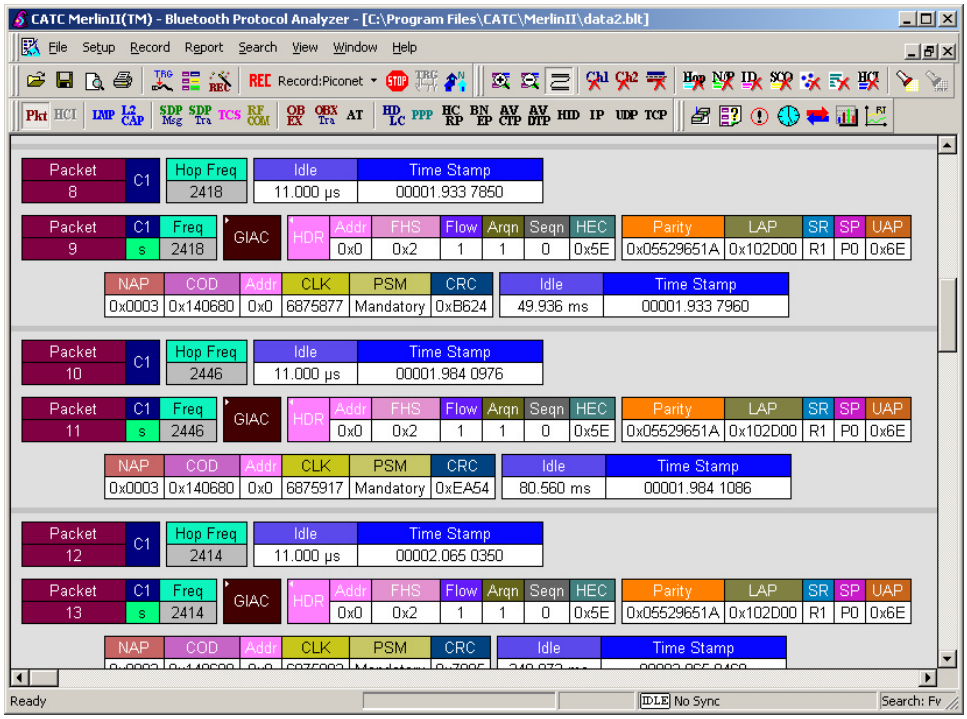
At the completion of the recording, Merlin II will display the following screen:


Recording Wizard: New piconet (Step 8 of 8)
Merlin II has completed the recording of the traffic in the piconet using 'Page Sync & & Record' mode
Press 'Repeat' to have Merlin II re-initiate the recording process.
Repeat
Press 'Cancel' to terminate the synchronization and record attempts and to close the wizard.
< Back
Finish
Cancel
Help

You can repeat the recording by pressing the **Repeat** button.

Step 11 To close the wizard, press the **Close** button.

The wizard will close and your trace will display.

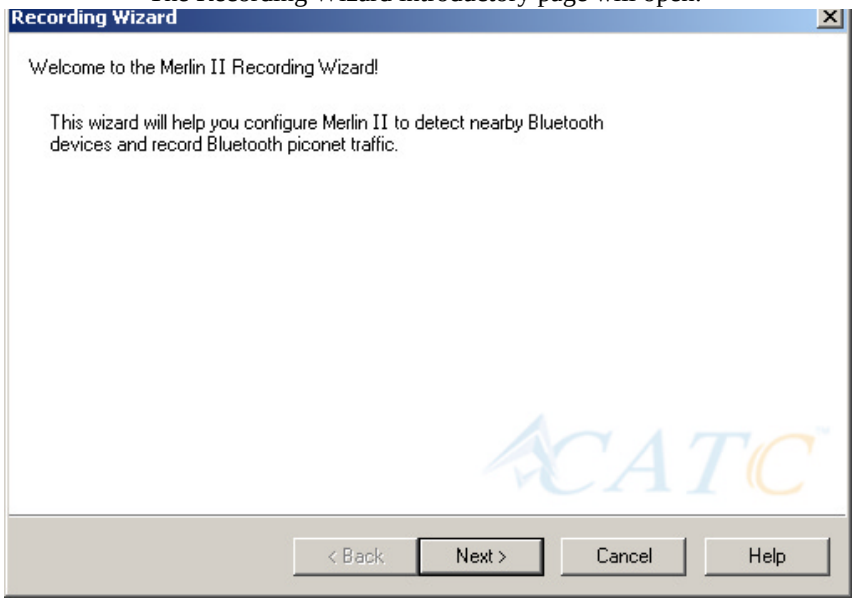

CATC MerlinII(TM) - Bluetooth Protocol Analyzer - [C:\Program Files\CATC\MerlinII\data2.blt]
File Setup Record Report Search View Window Help
REC Record:Piconet
Packet 8 C1 Hop Freq 2418 Idle 11.000 µs Time Stamp 00001.933 7850
Packet 9 C1 s Freq 2418 GIAC HDR Addr 0x0 FHS 0x2 Flow 1 Arqn 1 Seqn 0 HEC 0x5E Parity 0x05529651A LAP 0x102D00 SR R1 SP P0 UAP 0x6E
NAP 0x0003 COD 0x140680 Addr 0x0 CLK 6875877 PSM Mandatory CRC 0xB624 Idle 49.936 ms Time Stamp 00001.933 7960
Packet 10 C1 Hop Freq 2446 Idle 11.000 µs Time Stamp 00001.984 0976
Packet 11 C1 s Freq 2446 GIAC HDR Addr 0x0 FHS 0x2 Flow 1 Arqn 1 Seqn 0 HEC 0x5E Parity 0x05529651A LAP 0x102D00 SR R1 SP P0 UAP 0x6E
NAP 0x0003 COD 0x140680 Addr 0x0 CLK 6875917 PSM Mandatory CRC 0xEA54 Idle 80.560 ms Time Stamp 00001.984 1086
Packet 12 C1 Hop Freq 2414 Idle 11.000 µs Time Stamp 00002.065 0350
Packet 13 C1 s Freq 2414 GIAC HDR Addr 0x0 FHS 0x2 Flow 1 Arqn 1 Seqn 0 HEC 0x5E Parity 0x05529651A LAP 0x102D00 SR R1 SP P0 UAP 0x6E
NAP COD Addr CLK PSM CRC Idle Time Stamp
Ready
IDLE No Sync
Search: Fv

5.2 Recording an Existing Piconet

Using Recording Wizard to record an existing piconet is similar to recording a new piconet. The main difference is that you will be asked if your Master device can support multiple slave devices and whether it can respond to pages once it has created a piconet with another device.

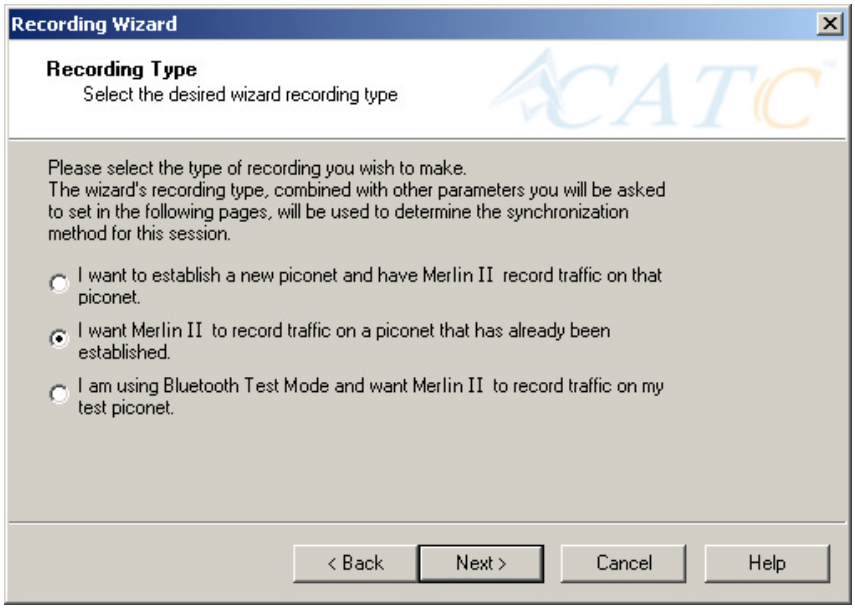
Step 1 To start the Recording Wizard, press or select **Setup** > **Recording Wizard** from the menu.

The Recording Wizard introductory page will open:


Recording Wizard
Welcome to the Merlin II Recording Wizard!
This wizard will help you configure Merlin II to detect nearby Bluetooth devices and record Bluetooth piconet traffic.
< Back
Next >
Cancel
Help

Step 2 Press **Next** to advance to the next screen.

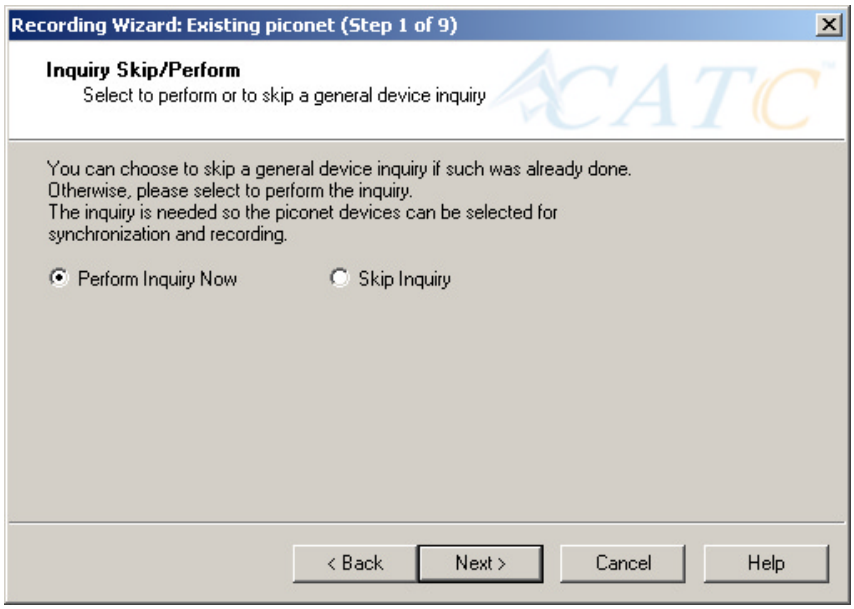
You will see three choices:


Recording Wizard
Recording Type
Select the desired wizard recording type
Please select the type of recording you wish to make.
The wizard's recording type, combined with other parameters you will be asked to set in the following pages, will be used to determine the synchronization method for this session.
I want to establish a new piconet and have Merlin II record traffic on that piconet.
I want Merlin II to record traffic on a piconet that has already been established.
I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.
< Back
Next >
Cancel
Help

Step 3 Select the second option: **I want Merlin II to record traffic on a piconet that has already been established**.

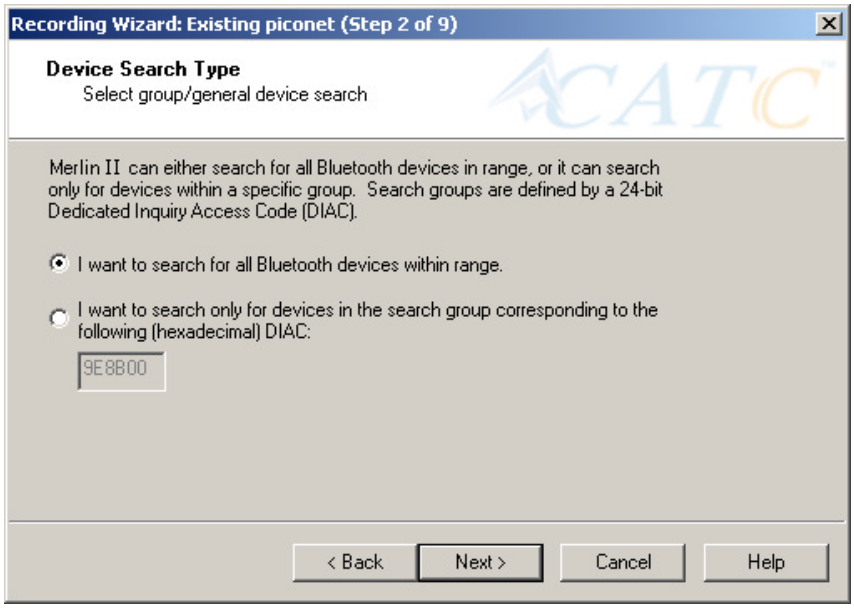
Step 4 Press **Next**.

You will see two choices:


Recording Wizard: Existing piconet (Step 1 of 9)
Inquiry Skip/Perform
Select to perform or to skip a general device inquiry
You can choose to skip a general device inquiry if such was already done.
Otherwise, please select to perform the inquiry.
The inquiry is needed so the piconet devices can be selected for
synchronization and recording.
Perform Inquiry Now
Skip Inquiry
< Back
Next >
Cancel
Help

Step 5 Select **Perform Inquiry Now**.

You will see two choices:

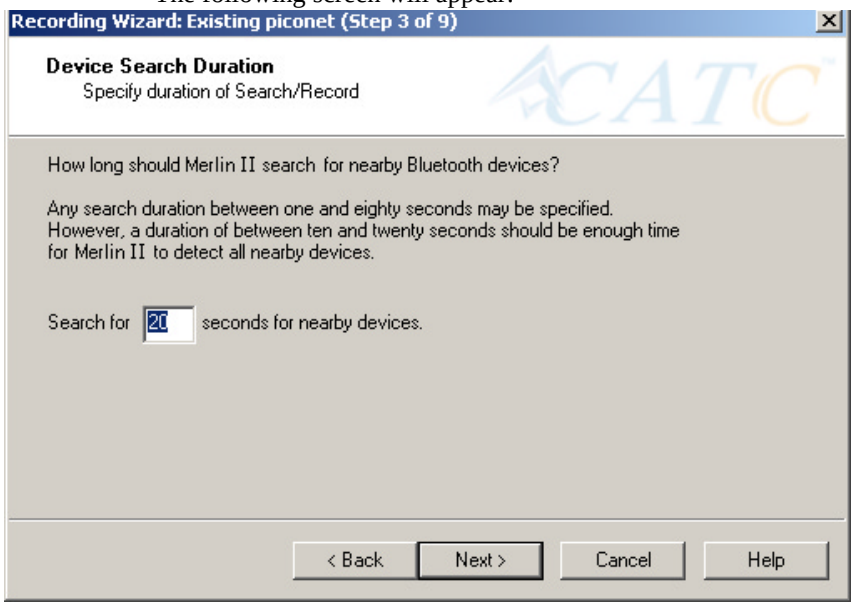

Recording Wizard: Existing piconet (Step 2 of 9)
Device Search Type
Select group/general device search
Merlin II can either search for all Bluetooth devices in range, or it can search
only for devices within a specific group. Search groups are defined by a 24-bit
Dedicated Inquiry Access Code (DIAC).
I want to search for all Bluetooth devices within range.
I want to search only for devices in the search group corresponding to the
following (hexadecimal) DIAC:
9E8B00
< Back
Next >
Cancel
Help

Step 6 Select the first option: **I want Merlin II to search for all Bluetooth devices within range**.

If you want to limit the inquiry to a class of devices, select the second option and enter the hexadecimal value for the device class in the text box.

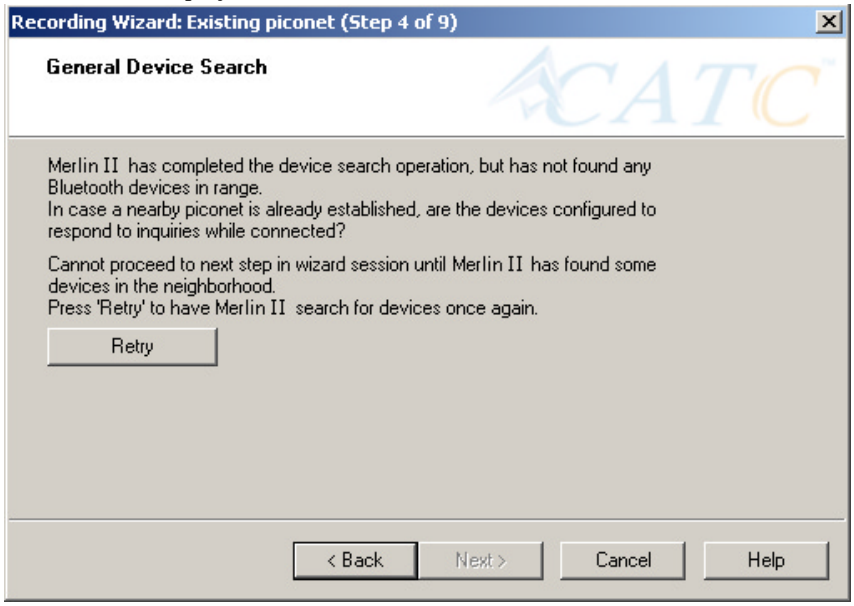
Step 7 Press **Next**.

The following screen will appear:

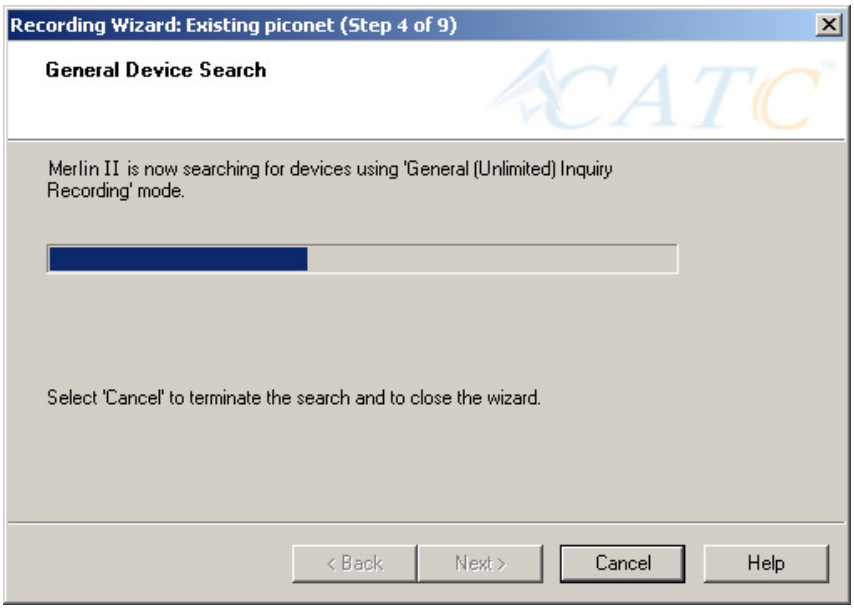

Recording Wizard: Existing piconet (Step 3 of 9)
Device Search Duration
Specify duration of Search/Record
How long should Merlin II search for nearby Bluetooth devices?
Any search duration between one and eighty seconds may be specified.
However, a duration of between ten and twenty seconds should be enough time
for Merlin II to detect all nearby devices.
Search for 20 seconds for nearby devices.
< Back
Next >
Cancel
Help

Step 8 If you want to change the search duration, type in a new value into the text box. Otherwise, use the default value (20 seconds), then press **Next**.

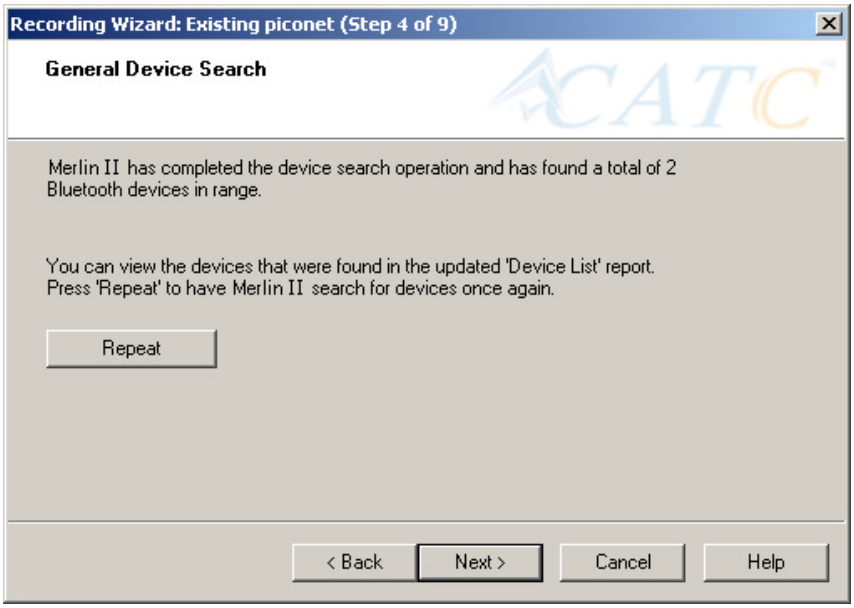
If Merlin II cannot detect other devices, the following message will display:


Recording Wizard: Existing piconet (Step 4 of 9)
General Device Search
Merlin II has completed the device search operation, but has not found any
Bluetooth devices in range.
In case a nearby piconet is already established, are the devices configured to
respond to inquiries while connected?
Cannot proceed to next step in wizard session until Merlin II has found some
devices in the neighborhood.
Press 'Retry' to have Merlin II search for devices once again.
Retry
< Back
Next >
Cancel
Help

If Merlin II passes the hardware test, it will then goes onto conduct a General Inquiry to locate local Bluetooth devices.


Recording Wizard: Existing piconet (Step 4 of 9)
General Device Search
Merlin II is now searching for devices using 'General (Unlimited) Inquiry Recording' mode.
Select 'Cancel' to terminate the search and to close the wizard.
< Back
Next >
Cancel
Help

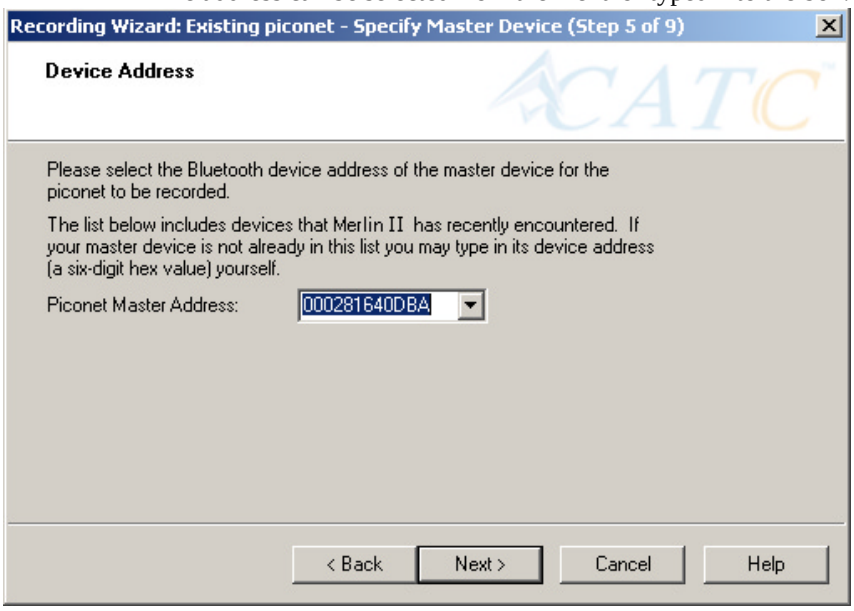
If Merlin II finds Bluetooth devices, it will display the following message:


Recording Wizard: Existing piconet (Step 4 of 9)
General Device Search
Merlin II has completed the device search operation and has found a total of 2 Bluetooth devices in range.
You can view the devices that were found in the updated 'Device List' report. Press 'Repeat' to have Merlin II search for devices once again.
Repeat
< Back
Next >
Cancel
Help

Check the Device List to see if Merlin II found all of the devices in your piconet. If you feel that the list is incomplete, you can close this window and press the button marked **Repeat**. This will cause Merlin II to repeat the General Inquiry and recollect information on local Bluetooth devices.

Step 9 Press **Next** to advance to the next screen.

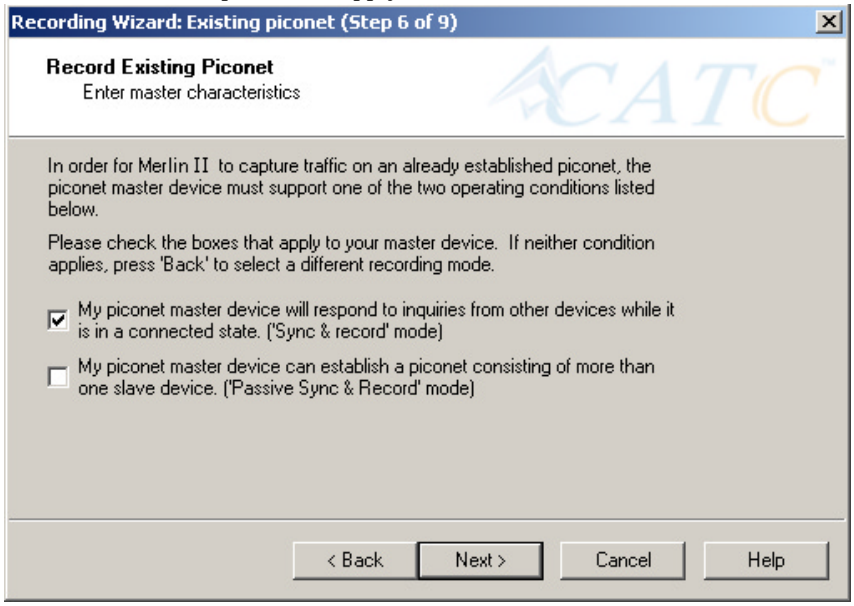
The following screen will prompt you for the Master device's address. The address can be selected from the menu or typed into the box:


Recording Wizard: Existing piconet - Specify Master Device (Step 5 of 9)
Device Address
Please select the Bluetooth device address of the master device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Piconet Master Address:
000281640DBA
< Back
Next >
Cancel
Help

Step 10 Select or type in the Master device's address into the box next to the label **Piconet Master Address**.

Step 11 Press **Next**.

The following screen will display. This screen asks you which of the following two options apply to your Master device. For some devices, both options will apply.


Recording Wizard: Existing piconet (Step 6 of 9)
Record Existing Piconet
Enter master characteristics
In order for Merlin II to capture traffic on an already established piconet, the piconet master device must support one of the two operating conditions listed below.
Please check the boxes that apply to your master device. If neither condition applies, press 'Back' to select a different recording mode.
My piconet master device will respond to inquiries from other devices while it is in a connected state. ('Sync & record' mode)
My piconet master device can establish a piconet consisting of more than one slave device. ('Passive Sync & Record' mode)
< Back
Next >
Cancel
Help

You can select either or both options. They are not mutually exclusive:

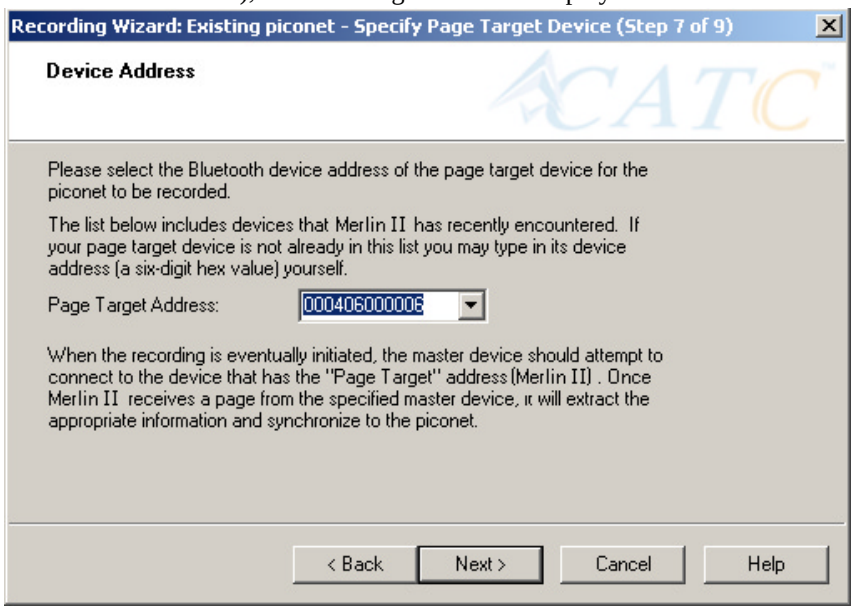
If the Master supports inquiries while in a connected state, select the first option. This will set Merlin II to use the 'Sync & Record' mode in its attempts to synchronize to the Master. This will also cause the wizard to skip to step 8.

If the Master can support piconets with multiple slaves, select the second option. If you select this box alone (i.e., you leave the first box unchecked), Merlin II will use the 'Passive Sync & Record' mode to synchronize to the Master. The wizard will then advance to Screen 8*.

If the first checkbox was selected, Merlin II will use 'Sync & Record' no matter what was set in the second box.

Step 12 If you want to skip the Master verification, put a check in the box. If you are in doubt, leave the box unchecked.

If you selected only the second option in Step 12 (='Passive Sync & Record'), the following screen will display.


Recording Wizard: Existing piconet - Specify Page Target Device (Step 7 of 9)
Device Address
Please select the Bluetooth device address of the page target device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your page target device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Page Target Address:
000406000008
When the recording is eventually initiated, the master device should attempt to connect to the device that has the "Page Target" address (Merlin II). Once Merlin II receives a page from the specified master device, it will extract the appropriate information and synchronize to the piconet.
< Back
Next >
Cancel
Help

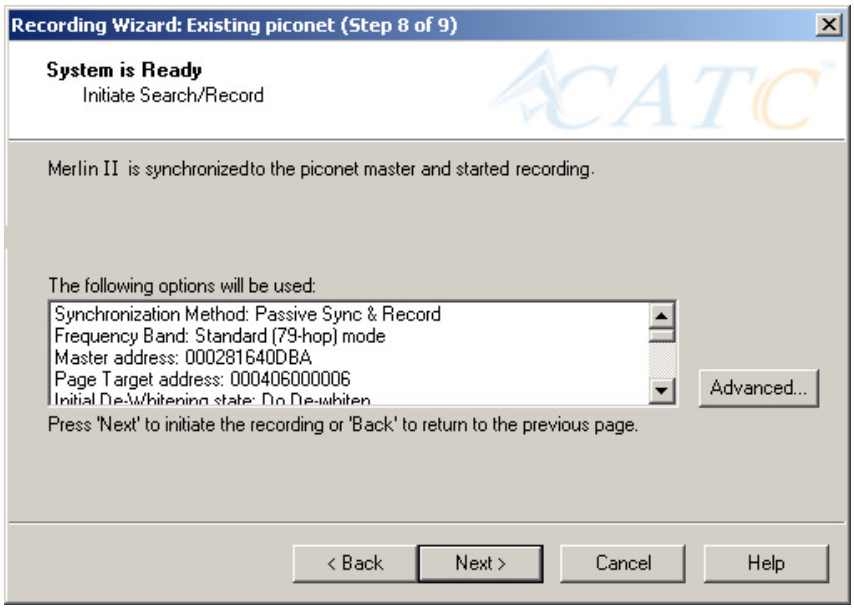
This screen asks you for the address of the Page Target device -- which in this case is Merlin II. Since the devices in your piconet are not able to respond to inquiries, Merlin II will not be able to page the devices and join the piconet. Instead, you will assign Merlin II an address here in this screen, then direct your piconet Master device to connect to Merlin II. The Master will attempt to connect to Merlin II and therein give Merlin II the information it needs to record the Master and slave devices.

Step 13 Type in an address of your choosing for Merlin II (= Page Target).

You are making up an address for Merlin II that the Master will use to try to connect to Merlin II.

Step 14 Press **Next**

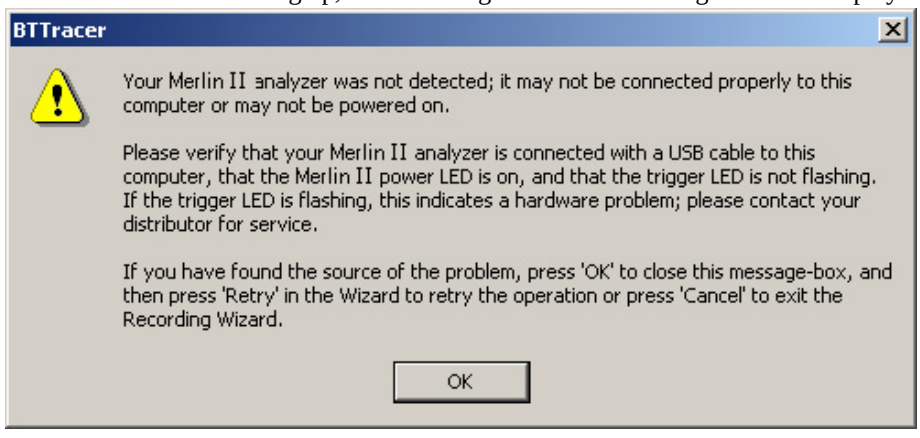
Merlin II will then display your current settings.


Recording Wizard: Existing piconet (Step 8 of 9)
System is Ready
Initiate Search/Record
Merlin II is synchronizedto the piconet master and started recording.
The following options will be used:
Synchronization Method: Passive Sync & Record
Frequency Band: Standard (79-hop) mode
Master address: 000281640DBA
Page Target address: 000406000006
Initial De-Whitening state: Do De-whiten
Advanced...
Press 'Next' to initiate the recording or 'Back' to return to the previous page.
< Back
Next >
Cancel
Help

The **Advanced** button will open the Recording Options dialog box shown on page 45 and described in detail in Chapter 7.

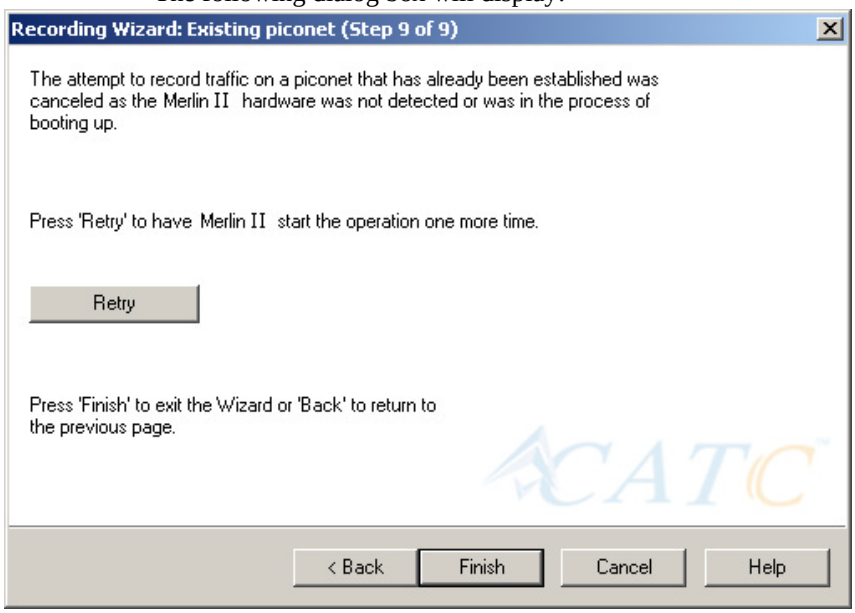
Step 15 Press **Next** to begin the recording.

If the Merlin II hardware is not ready or connected or is in the process of booting up, the following information message box will display:


BTTracer
Your Merlin II analyzer was not detected; it may not be connected properly to this computer or may not be powered on.
Please verify that your Merlin II analyzer is connected with a USB cable to this computer, that the Merlin II power LED is on, and that the trigger LED is not flashing. If the trigger LED is flashing, this indicates a hardware problem; please contact your distributor for service.
If you have found the source of the problem, press 'OK' to close this message-box, and then press 'Retry' in the Wizard to retry the operation or press 'Cancel' to exit the Recording Wizard.
OK

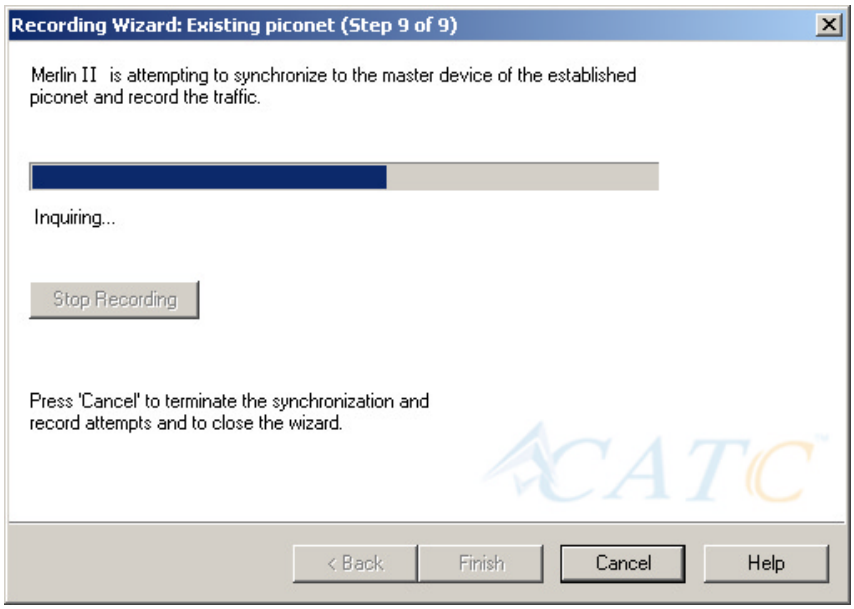
Step 16 If the above information box opened, press **OK** to close it.

The following dialog box will display:


Recording Wizard: Existing piconet (Step 9 of 9)
The attempt to record traffic on a piconet that has already been established was canceled as the Merlin II hardware was not detected or was in the process of booting up.
Press 'Retry' to have Merlin II start the operation one more time.
Retry
Press 'Finish' to exit the Wizard or 'Back' to return to the previous page.
< Back
Finish
Cancel
Help

Step 17 Press **Retry** or **Back** to re-attempt the process.

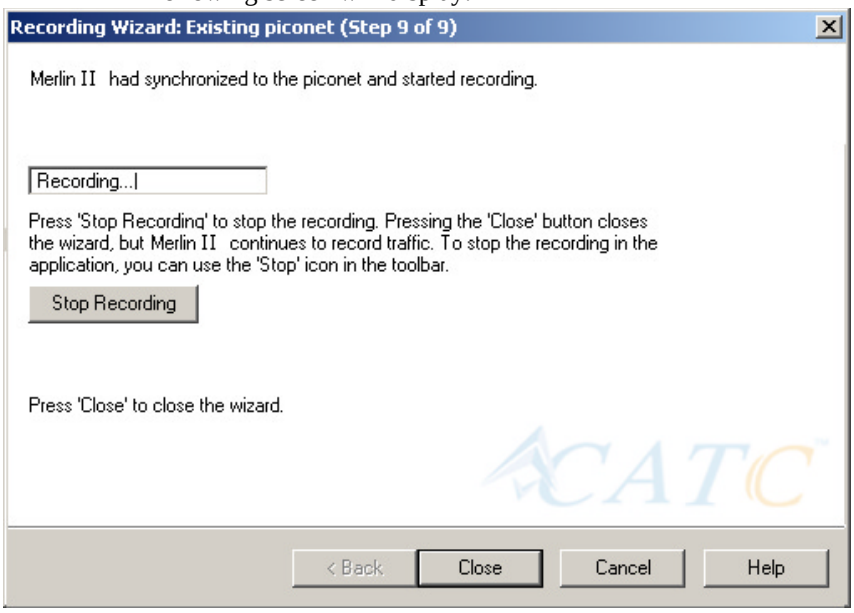
If the hardware failure described above do not occur, Merlin II will conduct an inquiry. The screen will show that Merlin II is going to attempt a recording in either 'Passive Sync & Record' mode as shown below or in 'Sync & Record' mode depending on the options you selected in Step 15.


Recording Wizard: Existing piconet (Step 9 of 9)
Merlin II is attempting to synchronize to the master device of the established piconet and record the traffic.
Inquiring...
Stop Recording
Press 'Cancel' to terminate the synchronization and record attempts and to close the wizard.
< Back
Finish
Cancel
Help

Step 18 If you are recording in 'Passive Sync & Record' mode, you will need to direct your Master device to attempt a connection to Merlin II. This will provide Merlin II with the information it needs to

record the piconet.

Once Merlin II has the information it needs, it will begin recording. The following screen will display:


Recording Wizard: Existing piconet (Step 9 of 9)
Merlin II had synchronized to the piconet and started recording.
Recording...
Press 'Stop Recording' to stop the recording. Pressing the 'Close' button closes the wizard, but Merlin II continues to record traffic. To stop the recording in the application, you can use the 'Stop' icon in the toolbar.
Stop Recording
Press 'Close' to close the wizard.
< Back
Close
Cancel
Help

The recording will end following a trigger event or when you press **Stop Recording** button on the screen shown above or when you press the button on the toolbar.

Step 19 When finished, press **Close** to close the Recording Wizard.

5.3 Recording in Test Mode

A Test Mode recording allows you to limit the frequency hopping range that Merlin II will record. Two Test Modes are available: Reduced Hopping Mode and Single Frequency Mode. Reduced Hopping Mode limits Merlin II's recording to the five frequency hops that are described in the Bluetooth Specification. Single Frequency Mode limits Merlin II's recording to a single frequency range that you specify in the Recording Wizard.

Recording in Reduced Hopping Mode

To record in Reduced Hopping Mode, perform the following steps:

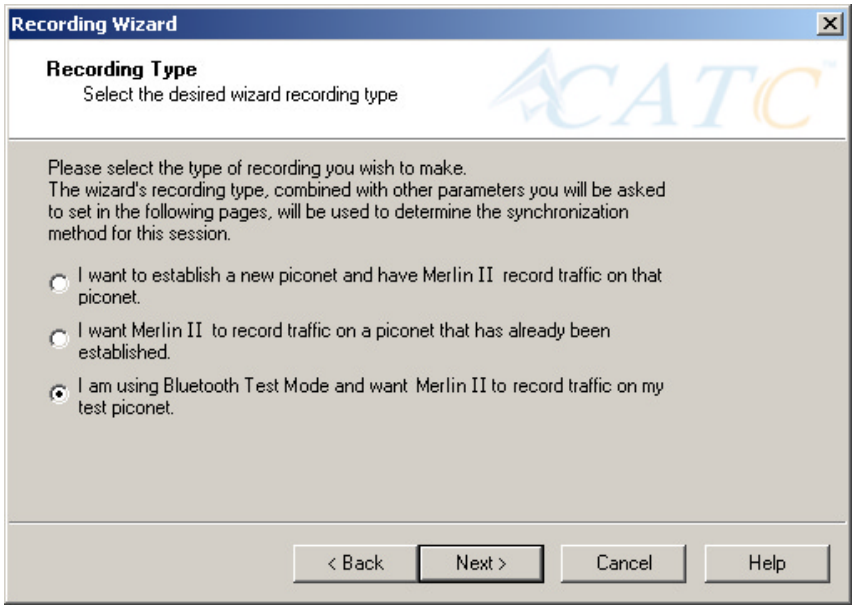
Step 1 Start the Recording Wizard by either pressing the button

or selecting **Setup > Recording Wizard** from the menu.

The Recording Wizard greeting screen will open.

Step 2 Press **Next** to advance to the **Recording Type** screen.

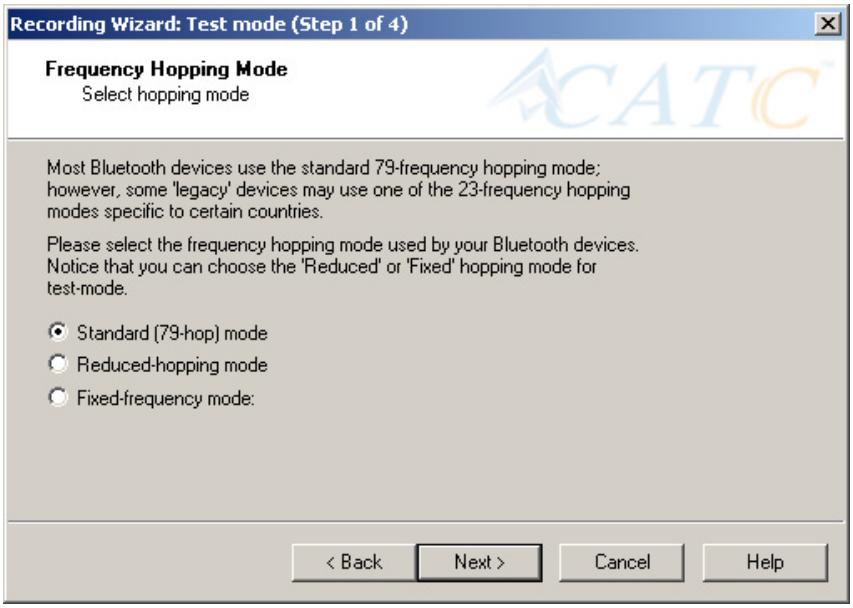
The following screen will display:


Recording Wizard
Recording Type
Select the desired wizard recording type
Please select the type of recording you wish to make.
The wizard's recording type, combined with other parameters you will be asked to set in the following pages, will be used to determine the synchronization method for this session.
I want to establish a new piconet and have Merlin II record traffic on that piconet.
I want Merlin II to record traffic on a piconet that has already been established.
I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.
< Back
Next >
Cancel
Help

Step 3 Select the third option: **I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.**

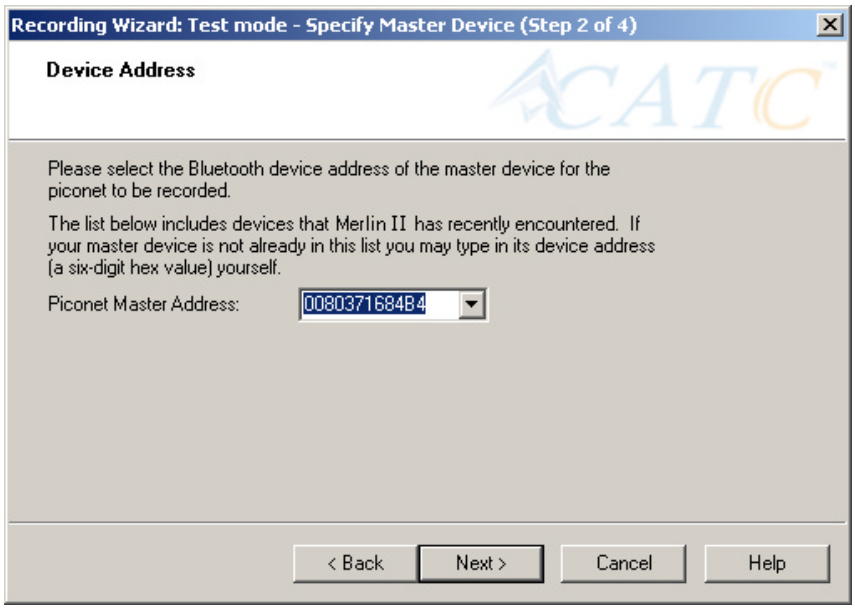
Step 4 Press **Next**.

The following screen will display:


Recording Wizard: Test mode (Step 1 of 4)
Frequency Hopping Mode
Select hopping mode
Most Bluetooth devices use the standard 79-frequency hopping mode; however, some 'legacy' devices may use one of the 23-frequency hopping modes specific to certain countries.
Please select the frequency hopping mode used by your Bluetooth devices. Notice that you can choose the 'Reduced' or 'Fixed' hopping mode for test-mode.
Standard (79-hop) mode
Reduced-hopping mode
Fixed-frequency mode:
< Back
Next >
Cancel
Help

Step 5 Select the option **Reduced-hopping mode**, then press **Next**.

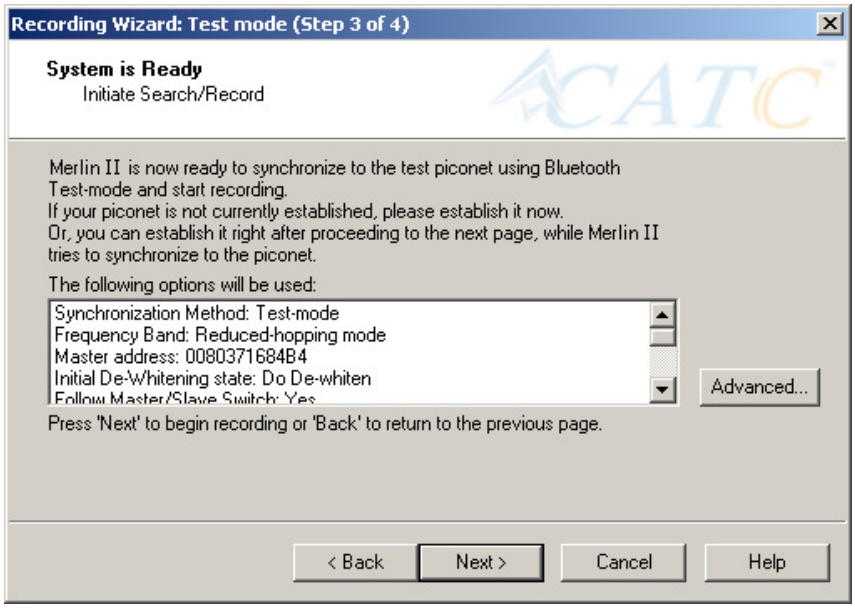
The following screen will display:


Recording Wizard: Test mode - Specify Master Device (Step 2 of 4)
Device Address
Please select the Bluetooth device address of the master device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Piconet Master Address:
0080371684B4
< Back
Next >
Cancel
Help

Step 6 Select the address for your piconet's Master device from the drop-down menu. If you prefer, you can type in the address into the box.

Step 7 Press **Next**.

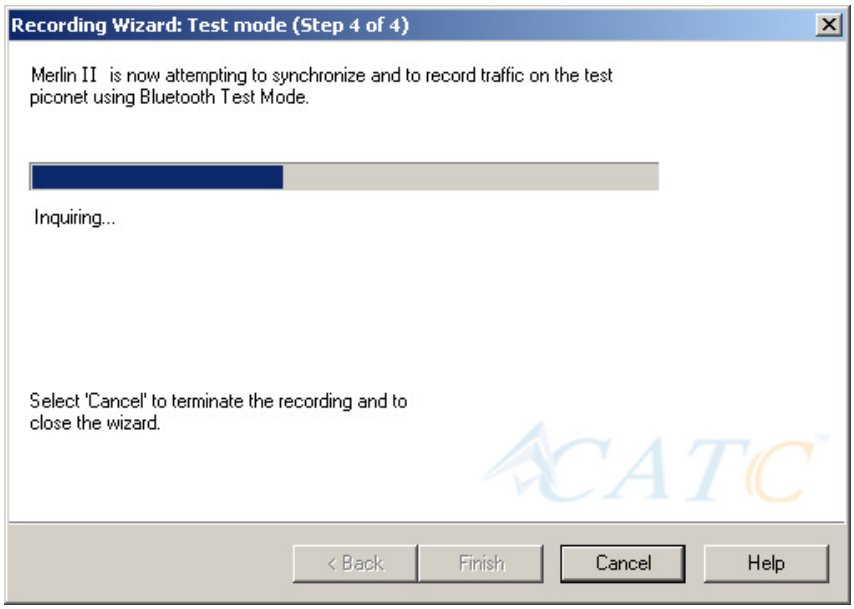
The following screen will display. This screen will show the current settings for the recording:


Recording Wizard: Test mode (Step 3 of 4)
System is Ready
Initiate Search/Record
Merlin II is now ready to synchronize to the test piconet using Bluetooth Test-mode and start recording.
If your piconet is not currently established, please establish it now.
Or, you can establish it right after proceeding to the next page, while Merlin II tries to synchronize to the piconet.
The following options will be used:
Synchronization Method: Test-mode
Frequency Band: Reduced-hopping mode
Master address: 0080371684B4
Initial De-Whitening state: Do De-whiten
Advanced...
Press 'Next' to begin recording or 'Back' to return to the previous page.
< Back
Next >
Cancel
Help

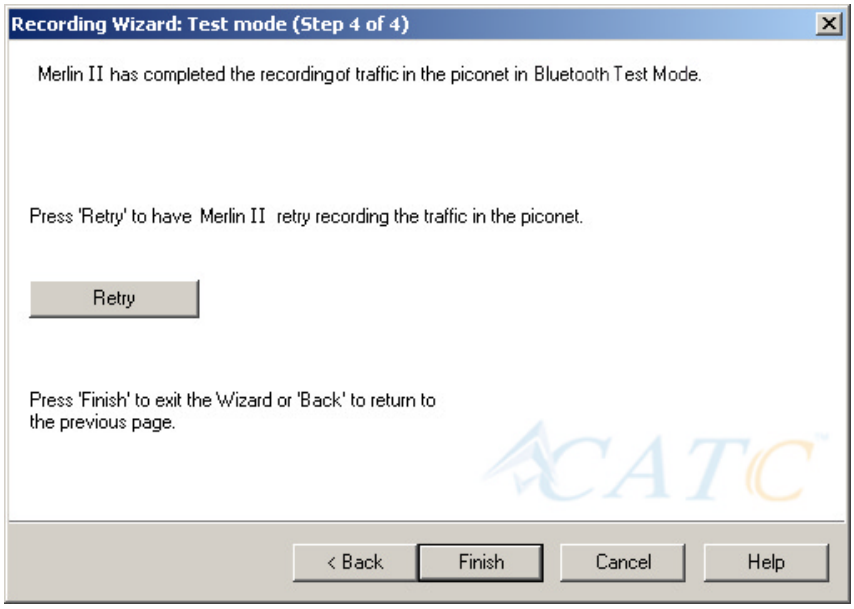
The Advanced button will open the Recording Options dialog box. See Chapter 7 for details on the Recording Options dialog box.

Step 8 Press **Next** to begin the recording.

The following screen will display:


Recording Wizard: Test mode (Step 4 of 4)
Merlin II is now attempting to synchronize and to record traffic on the test piconet using Bluetooth Test Mode.
Inquiring...
Select 'Cancel' to terminate the recording and to close the wizard.
< Back
Finish
Cancel
Help

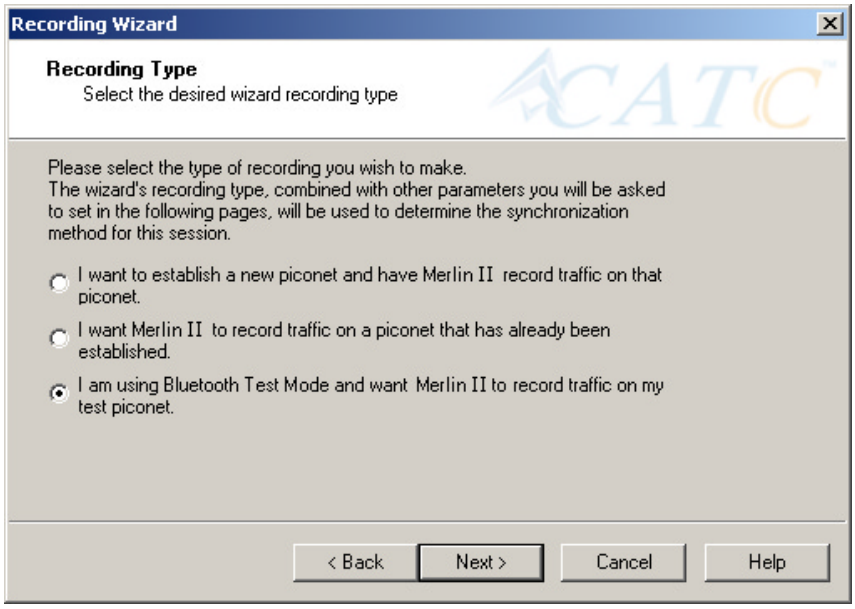
Step 9 When the recording finishes, the following screen will display. You can repeat the recording by pressing the **Repeat** button.


Recording Wizard: Test mode (Step 4 of 4)
Merlin II has completed the recording of traffic in the piconet in Bluetooth Test Mode.
Press 'Retry' to have Merlin II retry recording the traffic in the piconet.
Retry
Press 'Finish' to exit the Wizard or 'Back' to return to the previous page.
< Back
Finish
Cancel
Help

Step 10 To close the wizard, press **Finish**.

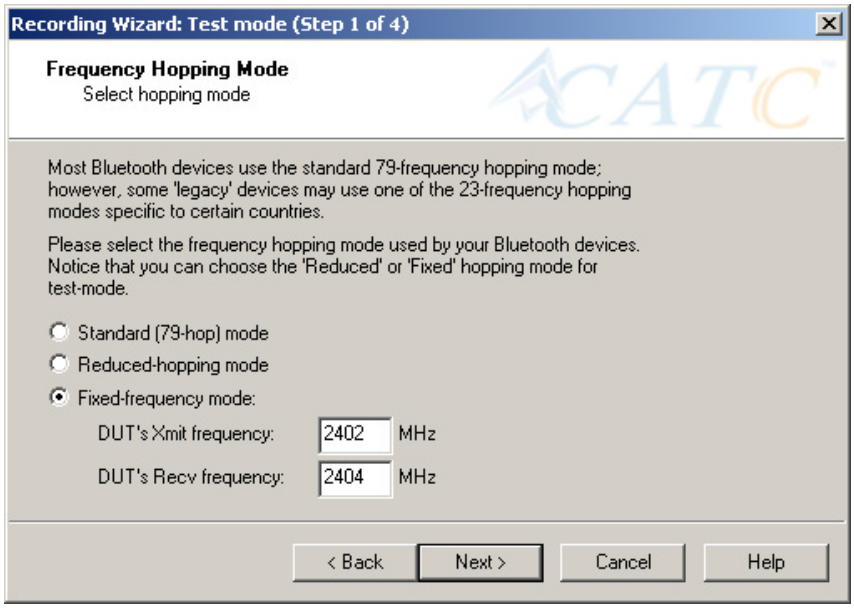
5.4 Recording in Single Frequency Mode

Step 1 In the Recording Type window, select the third radio button


Recording Wizard
Recording Type
Select the desired wizard recording type
Please select the type of recording you wish to make.
The wizard's recording type, combined with other parameters you will be asked to set in the following pages, will be used to determine the synchronization method for this session.
I want to establish a new piconet and have Merlin II record traffic on that piconet.
I want Merlin II to record traffic on a piconet that has already been established.
I am using Bluetooth Test Mode and want Merlin II to record traffic on my test piconet.
< Back
Next >
Cancel
Help

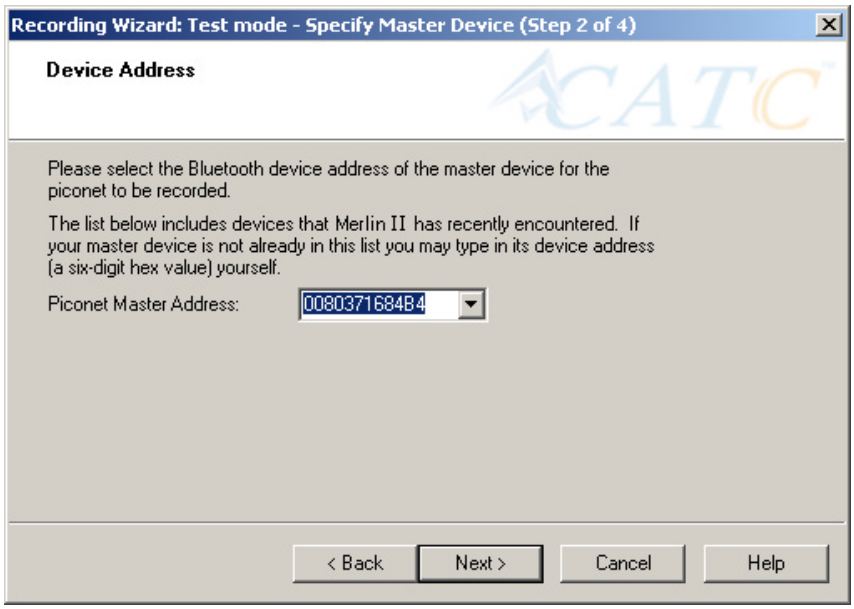
and click **Next**.

Step 2 In the **Frequency Hopping Mode**, window select the **Fixed-Frequency Mode** radio button, enter the appropriate values in the text boxes, and click **Next**.

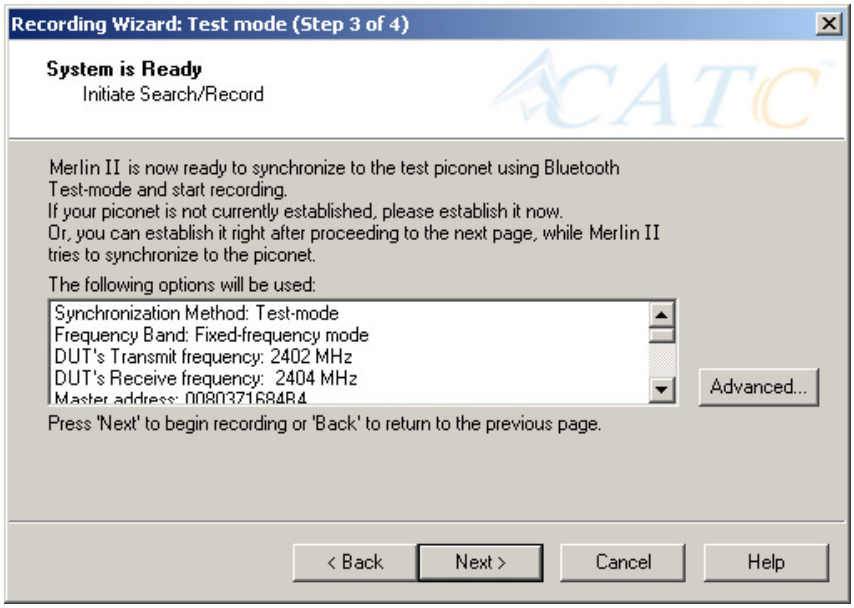

Recording Wizard: Test mode (Step 1 of 4)
Frequency Hopping Mode
Select hopping mode
Most Bluetooth devices use the standard 79-frequency hopping mode; however, some 'legacy' devices may use one of the 23-frequency hopping modes specific to certain countries.
Please select the frequency hopping mode used by your Bluetooth devices. Notice that you can choose the 'Reduced' or 'Fixed' hopping mode for test-mode.
Standard (79-hop) mode
Reduced-hopping mode
Fixed-frequency mode:
DUT's Xmit frequency: 2402 MHz
DUT's Recv frequency: 2404 MHz
< Back
Next >
Cancel
Help

Step 3 In the Master Device address box, enter the BD Address for

your Master Device.

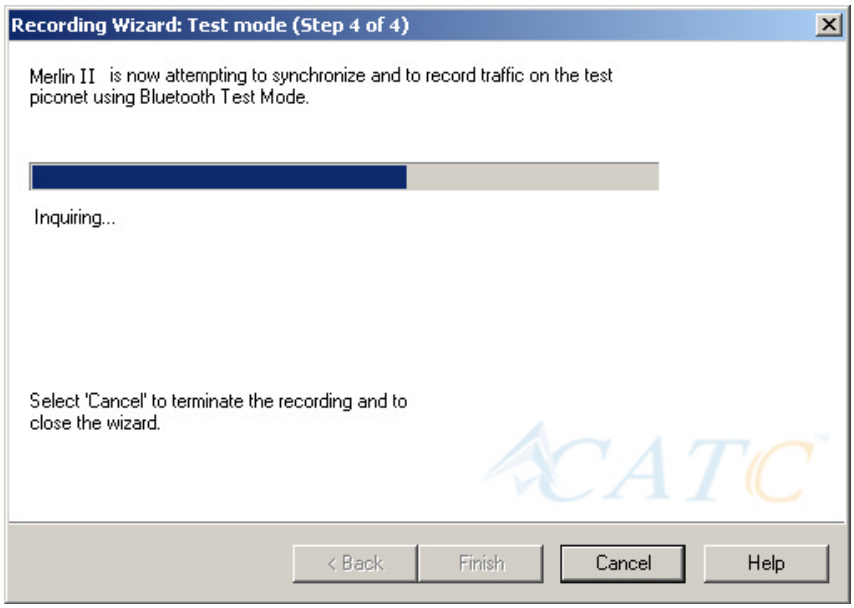

Recording Wizard: Test mode - Specify Master Device (Step 2 of 4)
Device Address
Please select the Bluetooth device address of the master device for the piconet to be recorded.
The list below includes devices that Merlin II has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.
Piconet Master Address:
00803716B4B4
< Back
Next >
Cancel
Help

Step 4 Press **Next**.


Recording Wizard: Test mode (Step 3 of 4)
System is Ready
Initiate Search/Record
Merlin II is now ready to synchronize to the test piconet using Bluetooth Test-mode and start recording.
If your piconet is not currently established, please establish it now.
Or, you can establish it right after proceeding to the next page, while Merlin II tries to synchronize to the piconet.
The following options will be used:
Synchronization Method: Test-mode
Frequency Band: Fixed-frequency mode
DUT's Transmit frequency: 2402 MHz
DUT's Receive frequency: 2404 MHz
Master address: 00803716B4B4
Advanced...
Press 'Next' to begin recording or 'Back' to return to the previous page.
< Back
Next >
Cancel
Help

Step 5 Press **Next**. Merlin II then synchronizes with the Master

device and begins recording.


Recording Wizard: Test mode (Step 4 of 4)
Merlin II is now attempting to synchronize and to record traffic on the test piconet using Bluetooth Test Mode.
Inquiring...
Select 'Cancel' to terminate the recording and to close the wizard.
< Back
Finish
Cancel
Help

6. Recording Options

While the Recording Wizard provides a "walk through" process for setting the recording options, you can get a more detailed view and set more parameters through the "Recording Options" dialog box. The Recording Options dialog box presents all of the settings needed to make a recording. Once you have selected your recording options, you then select the recording mode by clicking the down-arrow on the Record button and selecting from the two mode options: Piconet and Inquiry. Merlin II will then use the relevant Recording Options for the selected mode. For example, if you select **Piconet** recording mode, Merlin II will use the options from the **Piconet** page in the Recording Options dialog box.

6.1 Recording Modes

Pressing the down-arrow on the Record button displays a menu with two Recording Modes:

Selecting one of these modes tells the analyzer what sets of Recording Options it should use when you begin a recording.

Note: Selecting a Recording Mode from the menu does not cause the analyzer to begin recording. To begin recording, you must press the Recording button itself.

Piconet recording

Selecting **Piconet**, configures Merlin II to record piconet traffic using the parameters set in the Piconet page in the Recording Options dialog box. When you begin recording in this mode, Merlin II will to try to synchronize to a piconet that matches the Piconet parameters set in the Recording Options. The recorded traffic is captured off-the-air.

Inquiry recording

This mode configures Merlin II to record Inquiry traffic. When setting the Merlin II to Inquiry recording, the system is ready to perform a Bluetooth 'General' or 'Dedicated' inquiry, according to the parameters specified in the 'inquiry' page of the Recording Options. The recorded traffic would consist the transmitted packets as well as the responses received from Bluetooth devices in the area.

UT:HCI mode

Configures the system to exclusively record HCI traffic from IUTs. This recording mode bypasses the analyzer: HCI traffic from the IUT is recorded directly by the analyzer software without going through the analyzer. This means that you can record HCI traffic even if the analyzer is not turned on.

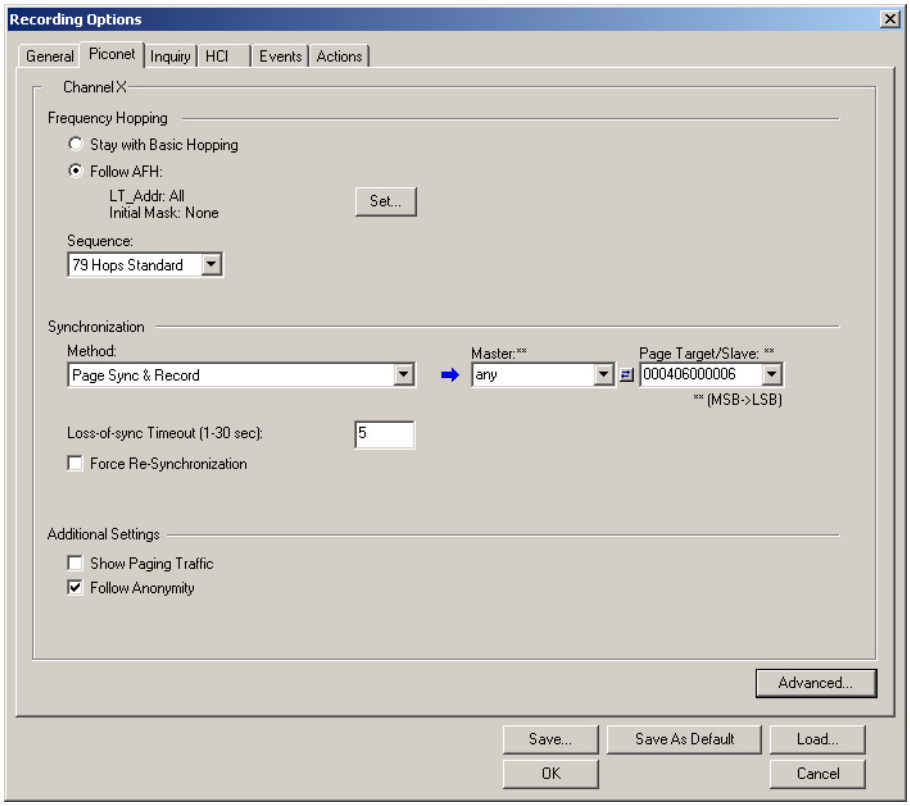
To record HCI traffic, first enable the recording of HCI traffic from IUTs. You do this in the HCI page of the Recording Options dialog. Then set the recording mode to something other than IUT:HCI. If you want to prevent the recording of HCI traffic from IUTs, disable it in the HCI page of the Recording Options dialog.

6.2 Opening the Recording Options Dialog Box

To open the **Recording Options** menu, click

on the Tool Bar or select **Recording Options** under **Setup** on the Menu Bar.

You see the **Recording Options** window. By default, the **Piconet** options page displays:

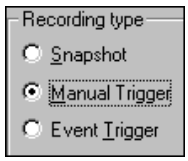


You will need to set options for each of the Recording Options pages. Generally, it is best to begin with the **General** and **Piconet** pages where you can set the type of recording, and then move on to the **Events** and **Actions** pages where you can set triggering events.

6.3 Recording Options - General

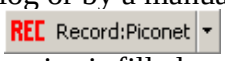
The General page controls the length of a recording and how it begins and ends. It is shown in the previous illustration. The General page display four boxes marked *Recording Type, Buffer Size, Trigger Position,* and *Options*.

Recording type



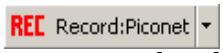
The **Recording Type** box presents options that control how Merlin II begins and ends a recording. The options are: *Snapshot, Manual Trigger,* and *Event Trigger.*

Snapshot

A Snapshot is a fixed-length recording whose size is determined by the "Buffer Size" box in the Recording Options dialog or by a manual click of the Stop button. Recording begins by clicking 

on the Tool Bar and ends when either the selected buffer size is filled or you press the Stop button.

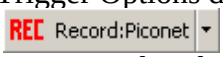
Manual Trigger

A Manual Trigger recording is a one that is manually begun and ended. Recording is begun by pressing 

on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Recording ends when

is clicked on the Tool Bar or the Trigger button is pressed on the analyzer's front panel. If you press the Trigger button, recording will continue until the post-trigger memory has been filled.

Event Trigger

An Event Trigger recording is one that uses an event trigger to end the recording. Before recording begins, you define the event trigger in the Trigger Options dialog box. You begin the recording by clicking 

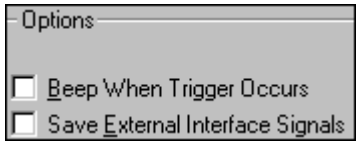
on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Once the trigger event occurs, some post-trigger recording occurs, then the recording ends.

Note In this mode, the recording can be stopped manually in the same way as for "manual trigger" mode.

Options

The Options box contains two options:

Beep When Trigger Occurs

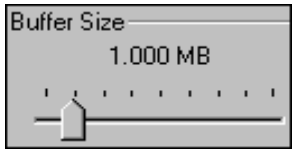


Will cause the PC to beep when a trigger event has occurred.

Save External Interface Signals

Will enable Merlin II to record input signals from a breakout board as fields in a trace.

Buffer Size

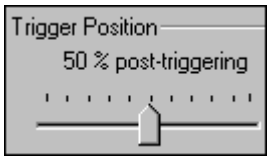


The Buffer Size box has a slide bar for adjusting the recording buffer size from 0.4 megabytes to 512 megabytes.

The Recording Type option determines how this buffer is used. Although there are 512 megabytes of physical memory in the analyzer, the efficiency of the recording ranges from 2:1 to 4:1 ratios of physical memory to actual Bluetooth traffic. Shorter Bluetooth packets yield a less efficient recording. The non-traffic portion of physical memory is utilized for control and timing information.

Note The scale is not linear and affords more granularity in the smaller buffer sizes.

Trigger Position



The Trigger Position slide bar sets the amount of post-trigger recording that Merlin II will perform. It also allows adjustment of the location of the trigger within the defined buffer. You can adjust the Triggering Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.

As an example, if the buffer size is set to 16MB, then for the following Trigger Position settings, the amount of pre- and post-Trigger data is

- 95% post-triggering: 0.8MB pre-trigger, 15.2MB post-trigger
- 75% post-triggering: 4MB pre-trigger, 12MB post-trigger
- 50% post-triggering: 8MB pre-trigger, 8MB post-trigger
- 25% post-triggering: 12MB pre-trigger, 4MB post-trigger
- 5% post-triggering: 15.2MB pre-trigger, 0.8MB post-trigger

Note When a Trigger occurs, recording continues until the post-Trigger amount of the buffer is filled.

Debug

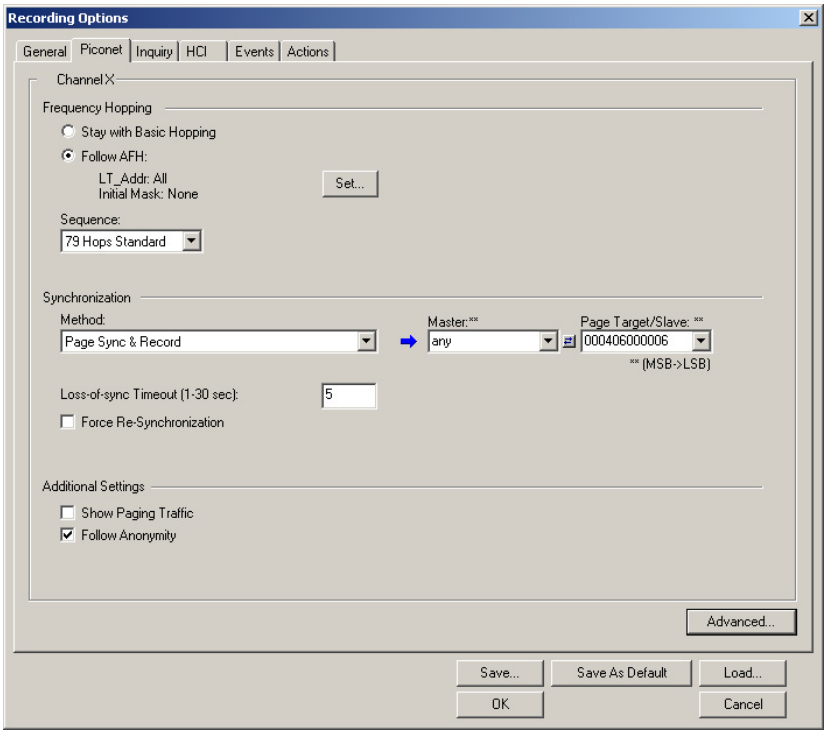
Enable CATC debug file

Checking this box enables the creation of a file that can be used by CATC Support to aid in debugging. This option should always be disabled unless you are requested to enable it by CATC personnel.

6.4 Recording Options - Piconet

The Recording Options dialog box has two pages for configuring how Bluetooth traffic is recorded: **Piconet,** which configures piconet recording sessions, and **Inquiry** which configures inquiry recording sessions.

For recording in Piconet mode, the **Piconet** page lets you specify the type of piconet you will be recording and how Merlin II should synchronize and record the piconet.

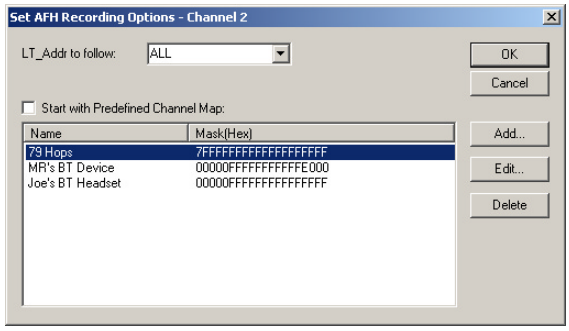


Frequency Hopping

Stay with Basic Hopping - Configures the probe to use the Basic Hopping sequence as defined by the Bluetooth 1.1 specification.

Follow AFH - Configures the probe to use the Adaptive Frequency Hopping sequence as defined by the Bluetooth 1.2 specification.

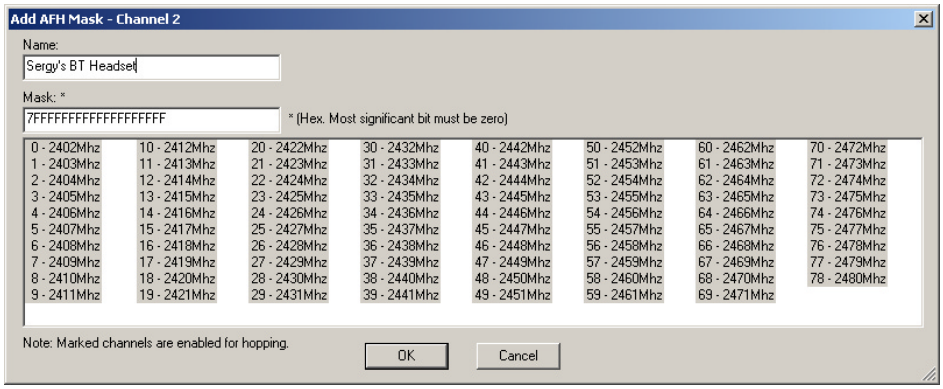
Set... - Opens a dialog box for selecting the channels you would like Merlin II to use.



LT_ADDr to Follow: Select devices to be followed.

Start with Predefined Channel Map: Tells Merlin II whether to use the selected channel map from the table. Select an AFH sequence from the list, check **Start with Predefined Channel Map**, then click **OK**.

Add ...: Opens a dialog box for selecting multiple channels. You can shift-click or control-click to select or deselect multiple channels. Add a name to the box marked **Name** and then click **OK** to close the dialog box and keep your selection.

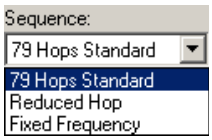


Edit ...: Opens the dialog box shown above and lets you change the current settings.

Delete: Deletes the selected AFH sequence.

Sequence

The **Sequence** field presents a drop-down menu with choices for the Hopping Sequence Standard:



- **79 Hops Standard** - Sets the analyzer to track regular piconet traffic with 79 channels hopping scheme.
- **Reduced Hop** - Used for test-mode recording.

  Restricts Merlin II to five hop frequencies defined in the test mode specification of the Bluetooth Specification. When Reduced Hop or Single Frequency is selected, the Sync method is set to **Test Mode** and cannot be modified by the user.

  A typical test-mode setup consists of a device under test (DUT) and a tester. In this hop sequence the devices are set to hop on a limited set of five frequencies. When recording in this mode, the analyzer does not use any of the **Synchronization** methods and the options under **Synchronization** become grayed out.

- **Fixed Frequency** - Allows the transmit and receive frequency ranges to be specified. This mode is used for test mode recording where the tester and DUT are transmitting and receiving on fixed frequencies.

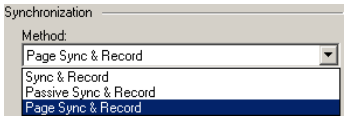
  Enter values into the two text boxes to the set the transmit and receive frequency ranges:

  - DUT Xmit Freq, MHz (+2402) – Allows the setting of the transmit signal for the Device Under Test
  - DUT Recv Freq, MHz (+2404) – Allows the setting of the receive signal for the Device Under Test

  When **Fixed Frequency** is selected, the Sync method is set to Test Mode and cannot be modified by the user.

Synchronization Method

Configures how the analyzer synchronizes to the piconet under observation. There are three methods of synchronization:



Sync and Record - Causes the analyzer to perform a general inquiry, acquire the Master's address and clock information, and then begin recording.

In this method, only the master address has to be specified. The analyzer performs a general Inquiry operation to learn the Master's hop frequency and clock information through FHS packets. Once the FHS packet of the specified piconet master is found, the analyzer begins recording using the frequency hop sequence derived from the FHS information of the piconet master.

Passive Sync & Record - In this method, both the master and paged target addresses have to be specified. When the analyzer attempts to synchronize to a piconet, it enters Inquiry Scan and awaits an inquiry from the device specified in the 'Master Address' field. When the master performs an inquiry the analyzer responds. Once the analyzer receives an FHS packet from the specified piconet master (through paging), the analyzer begins recording using the frequency hop sequence derived from the FHS information of the piconet master.

Passive Sync and Record is used with established piconets or private device networks.

Used in situations where the Master device and slave devices do not support Inquiry Scan mode.

Page Sync & Record - This is the recommended method of recording. In this synchronization method, the page target address has to be specified while the master address is optional. **Page Sync and Record** should be implemented before a piconet is established.

When the analyzer attempts to synchronize to a piconet using this method, it first performs a General Inquiry operation, searches for incoming FHS packets for the access code for the specified 'Page Target/Slave'. After the FHS packet of the specified slave is found, the analyzer waits for the master to begin paging the slave device. Once the paging process completes, the analyzer begins recording using the frequency hop sequence derived from the FHS information of the piconet master (captured during the paging process). In this Method, the master device can be a specific one (in which case its address should be explicitly selected in the 'Master Address' field) or can be any device (in which case the 'any' entry should be set in 'Master Address' field).

Test - This mode is automatically selected when one of the 'Fixed' or 'Reduced' hopping sequences has been selected. In this mode only Test-mode Bluetooth traffic of a setup with the master device specified in the 'Master Address' can be recorded.

Recording When Already Synchronized

If the analyzer were already synchronized to a piconet, it will not try to re-synchronize to the piconet that is defined in the Recording Options. Instead, it will immediately start the recording using the frequency hop sequence from the last recording operation. This results in shorter response time until the actual recording is started.

The analyzer will attempt to synchronize only in the following:

- The hopping sequence setting was modified from the last recording.
- The 'Force Re-Synchronization' flag is checked.

Master and Page Target Menus

To the right of the Sync Method menu are two menus which let you select or enter address for the devices in the piconet:

- **Master Address** - Presents a drop-down list of Master devices found previously. It also displays an option called **Any** which is used in **Page Sync and Record** to tell the analyzer to synchronize with any Master responding to the specified Page Target/Slave address.
- **Page Target** -- Presents a drop-down list of Page Target devices found previously. You can also enter address values in this box.

Between the two text boxes is the following button:

- - Swaps the Master and Page Target addresses.

When to Use the Different Piconet Recording Modes

Page Sync & Record is the preferred option and should be used whenever possible. If Page Sync & Record can not be used, then Sync & Record should be used. Passive Sync and Record should be used only if the first two options can not be used.

Sync & Record

Sync and Record works just like "Page Sync and Record" except that Merlin II takes its sync data directly from the Master instead of the Slave devices. With Sync and Record, Merlin II conducts a General Inquiry to get hop frequency and clock information from the Master. Merlin II then waits to detect piconet traffic from the Master device's piconet. When the piconet is established, Merlin II is able to synchronize to the Master and begin recording. In contrast to "Page Sync and Record", "Sync and Record" can be run with or without an established piconet.

Note This mode can only be used to find master devices that support Inquiry Scan.

To perform a "Sync and Record", follow the steps below:

Step 1 Turn on the Bluetooth devices under observation, and set up the master device so it is ready to respond to Inquiry scan. For a typical recording, ensure that the Master and Slave device(s) are not yet connected.

Step 2 In the Modes tab under Recording Options, enter the Master Device's address.

Step 3 Start Merlin II recording by pressing the Record button on the toolbar.

Step 4 When the analyzer is able to Sync up to the Piconet Master Clock, the Green **Sync** LED in the Merlin II front panel will start blinking.

Step 5 Establish connection between the Bluetooth devices under analysis.

Step 6 When Merlin II senses Piconet traffic, the Green **Sync** light goes ON solid, recording starts and the status bar in the bottom of the analyzer screen shows activity.

Recording may be stopped manually or when the recording buffer is filled.

Note After the Sync light starts blinking, a connection between the Bluetooth devices should be established within one (1) minute.

Passive Sync & Record

Passive Sync and Record is used in situations where the Master device and slave devices do not support Inquiry Scan mode. When selected, Merlin II enters Inquiry Scan and Page Scan mode and waits for a page from the Master device. When the piconet Master pages Merlin II, Merlin II obtains the information necessary for synchronization and then attempts to synchronize to the piconet controlled by that Master.

"Passive Sync and Record" is designed to be used with established piconets or *private device networks*.

Running "Passive Sync and Record" with Established Piconets

For most situations, "Passive Sync and Record" will be run after a piconet has been established. The steps are as follows:

Step 1 Establish a connection between two or more Bluetooth devices.

Step 2 Under General Recording Options, select "Passive Sync & Record."

Step 3 Under the Modes tab in Recording Options, enter the address for the piconet's master device.

Step 4 Make up an address for Merlin II and enter it into the Page Target address in the Modes tab in Recording Options. Make sure you do not select an address for any other local device.

Step 5 Press the record button on the toolbar in Merlin II to start a recording session.

Step 6 If necessary, have Master "discover" Merlin II through a General Inquiry.

Step 7 From the Master device, initiate a page to Merlin II address. This action will enable Merlin II to synchronize to the piconet. However, the analyzer will not complete the page sequence from the Master. This will cause the Master to time out in this request.

Step 8 At the end of this sequence, the green **Sync** light will go on solid, recording will begin and activity will be displayed on the status bar in the bottom of the analyzer screen.

Running "Passive Sync and Record" with Private Device Piconets

Because *private device networks* do not allow other devices to join the network, Merlin II needs to temporarily assume the identity of a slave in the network in order to join that network. To do this requires disabling the slave and beginning the operation without an established piconet. The following steps show the process.

Step 1 Turn the Master device on and the slave device off. You need the slave device turned off so that Merlin II can take its place in the piconet.

Step 2 Enter the slave's address into Merlin II's "Page Target" field in the Modes tab in the Recording Options dialog box.

Step 3 Run "Passive Sync and Record." The Master will then page the slave's address and Merlin II will be able to sync.

Step 4 When Merlin II synchronizes to the Master, turn the slave back on. When the Master re-pages the address the slave is admitted into the private network. Since Merlin II is passive in this mode, the slave and Merlin II do not conflict over the shared address. Merlin II is

then able to record the traffic between the Master and slave.

Page Sync & Record

"Page Sync and Record" is the recommended method of recording. "Page Sync and Record" should be implemented before a piconet is established. This mode causes Merlin II to perform a General Inquiry and collect sync information from the specified slave device when it responds. Merlin II then waits for the Master to begin paging the Slave devices. When paging begins, Merlin II synchronizes to the Master and begins recording.

Note In order for this mode to work, the intended Slave must support "inquiry scan".

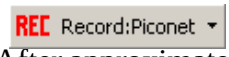
The following steps describe the simplest way to use this mode:

Step 1 Place both the "intended master" as well as its first "intended slave" into inquiry scan mode.

Step 2 Have Merlin II perform a General Inquiry. You do this by pressing the BT Neighborhood button

Step 3 After the General Inquiry completes, the addresses will populate the menus marked **Master Device** and **Page Target**. Select or enter the addresses for both your Master Device and Page Target.

Step 4 Click **OK** at the bottom of the window to close the Recording Options dialog box.

Step 5 Press the 

button found on Merlin II's toolbar. After approximately 11 seconds, the "SYNC" light on the front of Merlin II will begin to flash, meaning that Merlin II has acquired all the information it needs to fully synchronize with the piconet about to be established. At this point, you should establish the piconet using the devices previously defined as master and slave.

Note Inquiry Timeout is configurable (0 to 80 seconds) in the Recording Options General page.

Step 6 When the piconet is established, the "Sync" light on the front of Merlin II will change from flashing to solid, indicating that Merlin II is fully synchronized to the piconet and is currently recording all traffic within that piconet.

Note If the "sync" light on the front of Merlin II does not change from flashing to solid it means that Merlin II did not synchronize with the piconet when it was established.

Loss of Sync Timeout (1-30 secs)

This value specifies the amount of time that Merlin II will wait for piconet traffic before determining that synchronization has been lost.

Force Re-synchronization

"Force Re-Synchronization" forces Merlin II to re-synchronize at the beginning of each "Sync & Record," "Passive Sync & Record," or "Sync & Record" operation. By default, "Force Re-Synchronization" is disabled (i.e., unchecked).

Unchecking the "Force Re-Synchronization" checkbox tells Merlin II to use its existing data on Bluetooth devices, thereby bypassing the synchronization process and saving a few seconds from the beginning of the trace. If you know that Merlin II's data is correct, you can uncheck this checkbox and cause Merlin II to try to use the existing data. If the data is incomplete or incorrect, however, Merlin II will automatically perform a refresh.

To examine Merlin II's Bluetooth data, open the Device List (**View > Device List**).

Show Paging Traffic

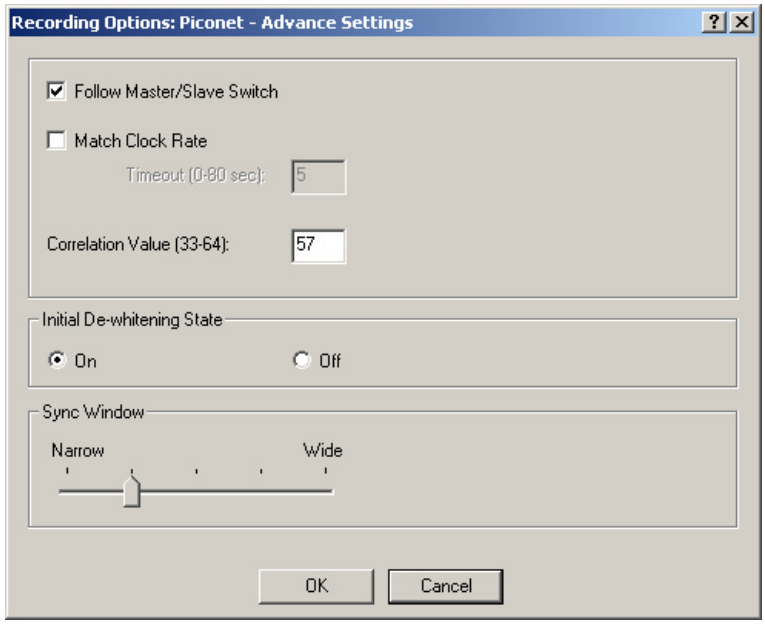
Show Paging Traffic causes Merlin II to capture paging traffic between the Master and Page Target devices. This option is used only with Page Sync and Record Mode.

Follow Anonymity

Allows Merlin II to follow devices that are using anonymity mode. Anonymity mode is an addressing mode in which devices are assigned Bluetooth addresses based on a pseudo-random value. Anonymity mode is defined in the Bluetooth 1.2 specification.

Advanced ...

The Advanced button opens a dialog box with additional piconet settings:



Follow Master/Slave Switch

If enabled, this option allows Merlin II to follow a role switch between a Master and Slave. This capability allows Merlin II to keep track of changes in a device's role when it changes from one role to another.

Merlin II is able to follow a role change by listening to the Slave device's Bluetooth clock and hop frequency as soon as it becomes a Master.

Match Clock Rate

Match Clock Rate is a useful option if the Master device's clock is inaccurate. Match Clock Rate causes Merlin II to do a General Inquiry to determine the Page Target's clock rate prior to synchronizing to the piconet. If unchecked, Merlin II will begin piconet synchronization without first doing a General Inquiry.

This option only works with Page Sync and Record mode.

Timeout (0-80 secs)

Default value for Inquiry Timeout is 20 seconds.

Correlation Value (33-64)

This value tells Merlin II how many bits in the sync word of each received packet must be matched in order for Merlin II to consider the packet valid and start recording.

This value specifies how long Merlin II should perform the Inquiry process for the General (unlimited) and Dedicated (limited) recording modes. After the specified time has elapsed, Merlin II will illuminate the trigger light on the front of the analyzer.

Initial De-whitening State

De-Whiten On -- Turns on De-Whitening

De-Whiten Off -- Turns off De-Whitening

This setting controls the initial de-whitening state.

If " De-Whitening Off" is selected, Merlin II will try to synchronize without de-whitening the received packets, and assume that they were transmitted un-whitened.

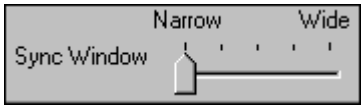
If " De-Whitening On" is selected, Merlin II will use received packets to try to synchronize while it is performing a de-whitening process that complies with Bluetooth specifications.

This setting controls the initial state for the synchronization. After Merlin II has synchronized to the piconet, it will try to follow changes in the whitening scheme and dynamically track whitened and non-whitened traffic.

In case a recording was stopped and you want to restart a recording session of the same piconet, you should remember that Merlin II might still be synchronized to the same piconet. As Merlin II dynamically follows whitening scheme changes, it will not use the initial de-whitening state. However, if you want to force an initial de-whitening state, check the "Force Re-Synchronization" flag.

Sync Window

The Sync Window slide bar controls the amount of time that Merlin II should wait between receiving an Inquiry Response (which will cause the Sync LED to blink) and detecting Master-Slave piconet traffic (which will cause the Sync LED to turn solid.)



A "Narrow" setting means that the wait time will be minimal, a "Wide" setting means it will be "maximal." The default is "Narrow" and this is suitable for most recordings. However, if significant drift occurs between Merlin II's clock and that of the Master, Merlin II may not be able to sync properly to the piconet. Under these conditions, you should move the slide bar towards the "Wide" Setting. The slide bar has five discrete settings.

After sync is established, Merlin II will remain in sync as long as there is piconet traffic.

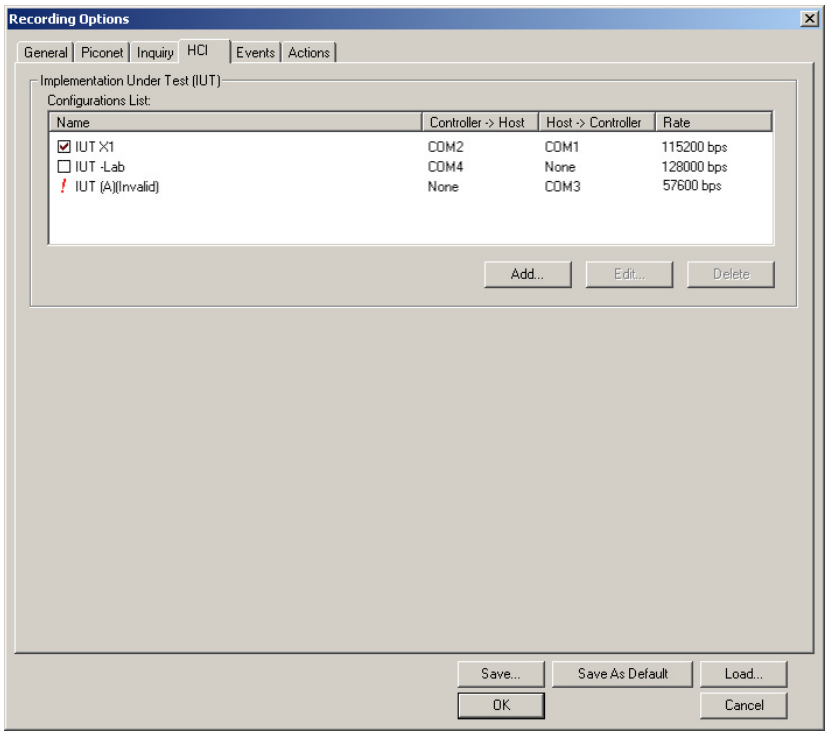
6.5 Recording Options - HCI

The HCI property page lets you configure the analyzer to record HCI traffic. HCI traffic consists of commands, events and data exchanged between a Bluetooth controller and a Bluetooth host.

HCI traffic is captured by a CATC-provided HCI probe that connects the Merlin II host PC and the IUT hardware. In this setup, the probe taps the signal in the IUT and transfers it to the Merlin II application.

In a typical setup, the HCI commands and data are passed from the Bluetooth application to the Bluetooth baseband (Host to Controller), while the received events and data are passed from the Bluetooth application (Controller to Host). It is also possible to forgo the probe and connect an IUT to several ports on the host PC.

See *Appendix B* for details about connecting a IUT to the PC and for information about configuring this page for an HCI recording.



6.6 Recording Options - Inquiry

The **Inquiry** page configures how Merlin II records Inquiry traffic. Two main options are presented in the **Sync Method** drop-down menu: General (Unlimited) Inquiry and Dedicated (Limited) Inquiry. These options tell Merlin II what kind of Inquiry traffic it should expect to record.

This page includes settings only for Inquiry recording and BT Neighborhood.

General (Unlimited)

Analyzer performs an Inquiry operation using the General/Unlimited Inquiry Access Code, or GIAC (0x9E8B33). During the Inquiry period that analyzer is recording all the FHS packets received in response until the specified timeout is reached.

Dedicated (Limited)

Analyzer performs an Inquiry operation using the Limited Dedicated Inquiry Access Code, or LIAC as set in the DIAC LAP field (the default is 0x9E8B00). During the inquiry period the analyzer is recording all the FHS packets received in response until the specified timeout is reached.

Timeout (0-80 secs)

Default value for Inquiry Timeout is 11 seconds. A value of 0 sets the Inquiry Timeout to "infinite inquiry."

Correlation Value (33-64)

This value tells Merlin II how many bits in the sync word of each received packet must be matched in order for Merlin II to consider the packet valid and start recording.

This value specifies how long Merlin II should perform the Inquiry process for the General (unlimited) and Dedicated (limited) recording modes. After the specified time has elapsed, Merlin II will illuminate the trigger light on the front of the analyzer.

BT Neighborhood

These options configure how the BT Neighborhood command behaves. BT Neighborhood is a utility that performs an Inquiry and then lists the local devices that it discovered.

- **Use Default settings** -- Sets the analyzer to record a General Inquiry with an Inquiry Timeout of 11 seconds.
- **Match 'Inquiry' Recording Settings** -- Sets the analyzer to use the settings you chose above under Hop Sequence, Inquiry Type,

and Additional Settings.

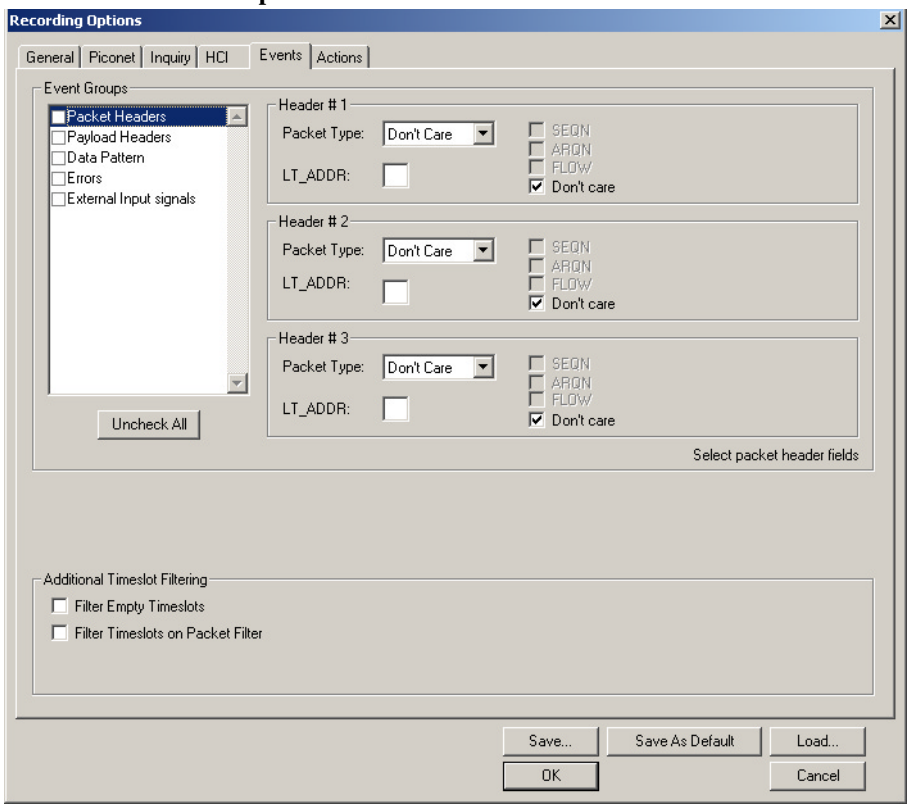
6.7 Recording Options - Events

If you have selected **Event Trigger** mode under the **General** tab in the Recording Options screen, you may now select specific Bluetooth events using the **Events** tab on the **Recording Option** Screen. You can also use the **Actions** tab to define specific event sequences that will trigger Merlin II to record a Bluetooth session.

In addition, the **Events** and **Actions** screens allow you to specify which packets you want to include or exclude from the recording.

- Click the **Events** tab on the **Recording Options** screen.

You see the **Event Groups** window:



The Event triggering and filtering options allow you to set event conditions for errors and/or a variety of packet characteristics.

Clicking a check box causes further options to display in the right side of the window.

Additional Timeslot Filtering

By default, Merlin II records frequency hop and timestamp information for all time slots in the Piconet under analysis, regardless of whether the time slot contained a Bluetooth packet. This means that in instances where there is little piconet traffic, Merlin II will display row after row of empty packets -- each representing an empty time slot. Through the use of timeslot filtering, these empty packets can be filtered out. Filtering out this information has the benefit of freeing memory so that more traffic can be recorded.

Filter Empty Slots

If "Filter Empty Slots" is checked, Merlin II will exclude all empty time slots from a recording except for those that lie immediately in front of Bluetooth communications packets. These remaining empty packets are preserved to give timestamp and frequency hop reference data to the packets that follow.

Filter Slots on Packet Filter

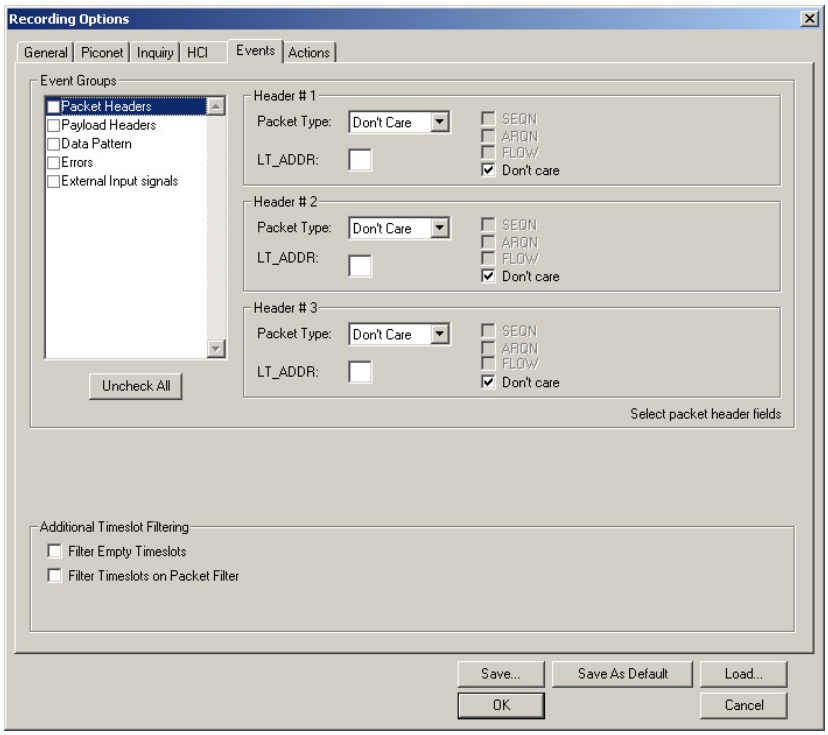
If filters are used to exclude FHS, DM1 or other packets, Merlin II will exclude these packets from a trace and mark their locations with empty packets. The result can be rows and rows of empty packets. The option "Filter Empty Slots" will not exclude these empty slots because they lie immediately in front of Bluetooth communications packets - even though those packets were not recorded. To eliminate these empty packets, select "Filter Slots on Packet Filter."

Packet Headers

Clicking "Packet Headers" opens three sets of check boxes and menus on the right that represent fields within packet headers: Packet Type, Active Member Address, Flow Control, Acknowledgment, and Sequence Number.

- Select **Packet Headers** under **Event Groups.**

  You see the **Packet Headers** window:



Packet Type

The Packet Type drop down menu lets you select the following packet types for filtering or triggering: NULL, POLL, FHS, DM1, DH1, HV1, HV2, HV3/EV3, DV, AUX1/PS, DM3, DH3, EV4, EV5, DM5, or DH5.

Select "Don't Care" if you want Merlin II to ignore this field.

LT_ADDR

(Logical Transport Address) The LT_ADDR is a three bit slave address. To select packets from a particular slave device for filtering or triggering, enter an address into the LT_ADDR text box. You can target up to three devices using the three text boxes.

SEQN, ARQN, and Flow Control Bits

To set event conditions on SEQN, ARQN, and Flow control, uncheck "Don't Care." Unchecking "Don't Care" sets the event condition to SEQN=0 AND ARQN=0 AND Flow=0. This action also puts a checkmark in the box marked "Packet Headers." A checkmark next to SEQN, ARQN, or Flow changes the value of this field from zero to one. For example, if SEQN is checked, the event condition becomes "SEQN=1 AND ARQN=0 AND Flow=0.

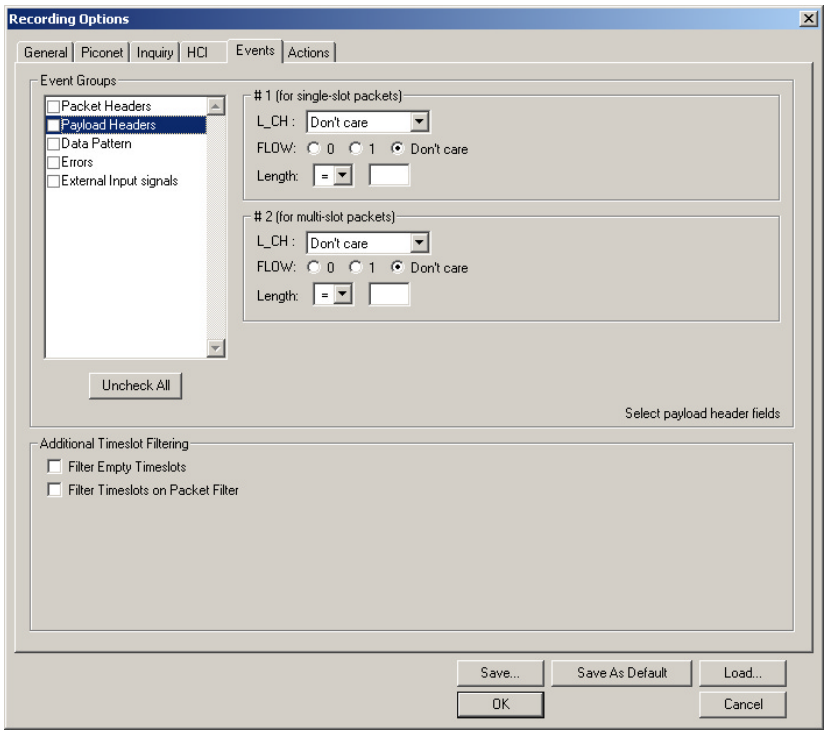
To cause Merlin II to ignore this set of check boxes, choose "don't care."

Payload Headers

Clicking "Payload Headers" causes a series of options to display on the right for setting conditions on payload headers. You will see two sets of options - one for single slot packets such as DM1 packets and a second for multi-slot packets such as DM3 packets. Within each set is a menu for the Logical Channel and sub-options for Flow Control, and Payload length. These latter two options allow you to modify searches based on the Logical Channel. An example would be "Trigger on a start L2CAP message whose flow control bit is 1 and whose data field length is less than 20."

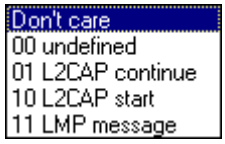
- Select **Payload Headers** under **Event Groups.**

  You see the **Payload Headers** window



L_CH (Logical Channel)

The "L_CH" drop down menu presents five options for setting conditions on the Logical Channel:



- Don't care
- 00 Undefined
- 01 L2CAP continue

- 10 L2CAP start
- 11 LMP message

Select "Don't care" if you do not want to set conditions on Logical Channel.

Flow

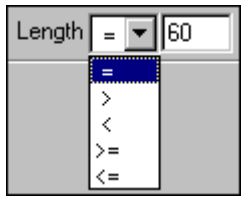
Three "radio buttons" are presented for setting conditions based on Flow control:

- 0
- 1
- Don't care

Flow works in conjunction with the Logical Channel (L_CH) menu - you select an option from the L_CH menu and then select an option under Flow.

Select "Don't care" if you do not want to set conditions on Flow control.

Length (in bytes)

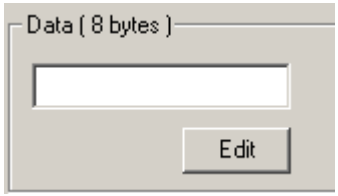


Using both the drop down menu and the text box, you can set conditions based on data field length. The maximum length for a single slot packet is 29 bytes. The maximum length for multi-slot packets is 339 bytes.

The drop-down menu gives you options for selecting operators such as "greater than" and "equal to." The text box to the right of the drop-down menu lets you enter values.

The Length option works in conjunction with the Logical Channel (L_CH) menu - you first select an option from the L_CH menu and then select an option under Length.

Data Patterns



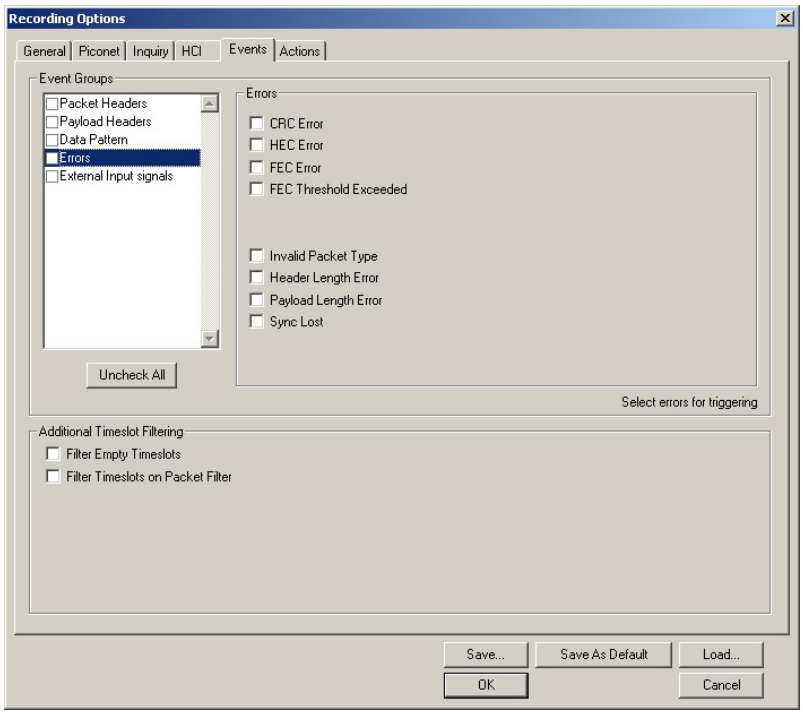
Clicking "Data Patterns" causes a text box to appear for entering patterns to be matched in the raw payload data. Patterns of up to eight hexidecimal bytes can be entered.

Errors

Clicking "Errors" causes check boxes to appear for setting conditions for triggering or filtering based on packet/signaling/protocol errors. You can select one or a combination of errors.

- Select **Errors** under **Event Groups.**

You see the **Errors** window:



Use any combination of the listed packet/signaling/protocol errors as a Trigger.

CRC Error

A CRC error in the packet data payload of the previous data packet.

HEC Error

An HEC (header error check) error in the packet header for the previous Bluetooth data packet.

FEC Error

An uncorrectable FEC (Forward Error Correction) error in the packet header for the previous Bluetooth data packet.

Threshold Exceeded

Indicates that the number of single-bit FEC errors detected since the current recording started has exceeded the specified value.

Invalid Packet Type

An invalid value was detected in the 'packet type' field of the packet header for the previous Bluetooth data packet.

Header Length Error

Indicates that a received Bluetooth data packet was terminated before all bits of the packet header were received.

Payload Length Error

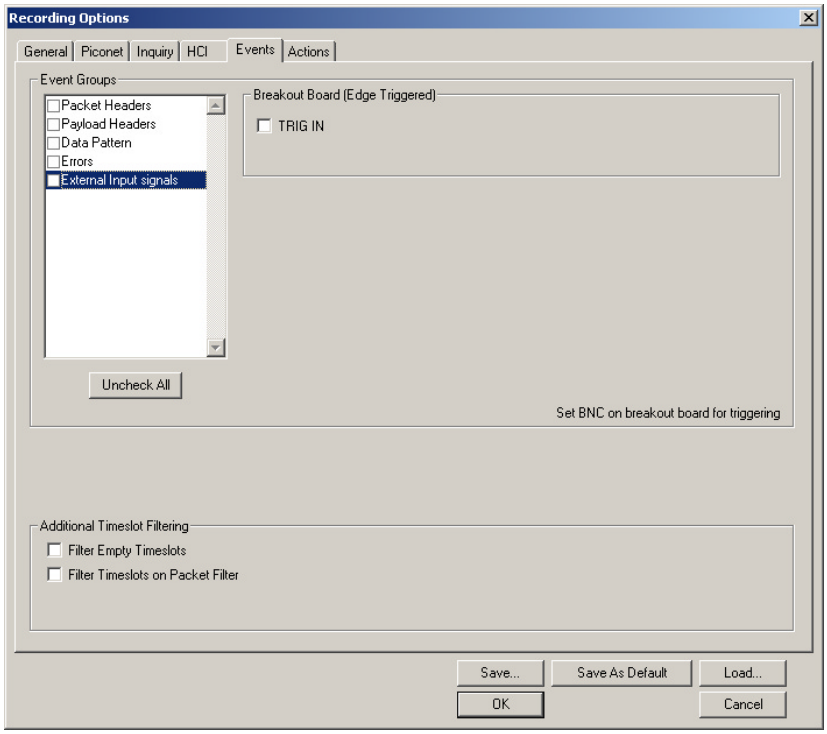
Indicates that the payload of a received Bluetooth data packet was either longer than expected, or that a Bluetooth data packet terminated before the expected end of the payload data.

Sync Loss

When set, indicates that a loss of piconet synchronization occurred during the frequency slot prior to this slot.

External Input Signals

Selecting "External Input Signals" causes the analyzer to trigger on an external signal received from the breakout board.



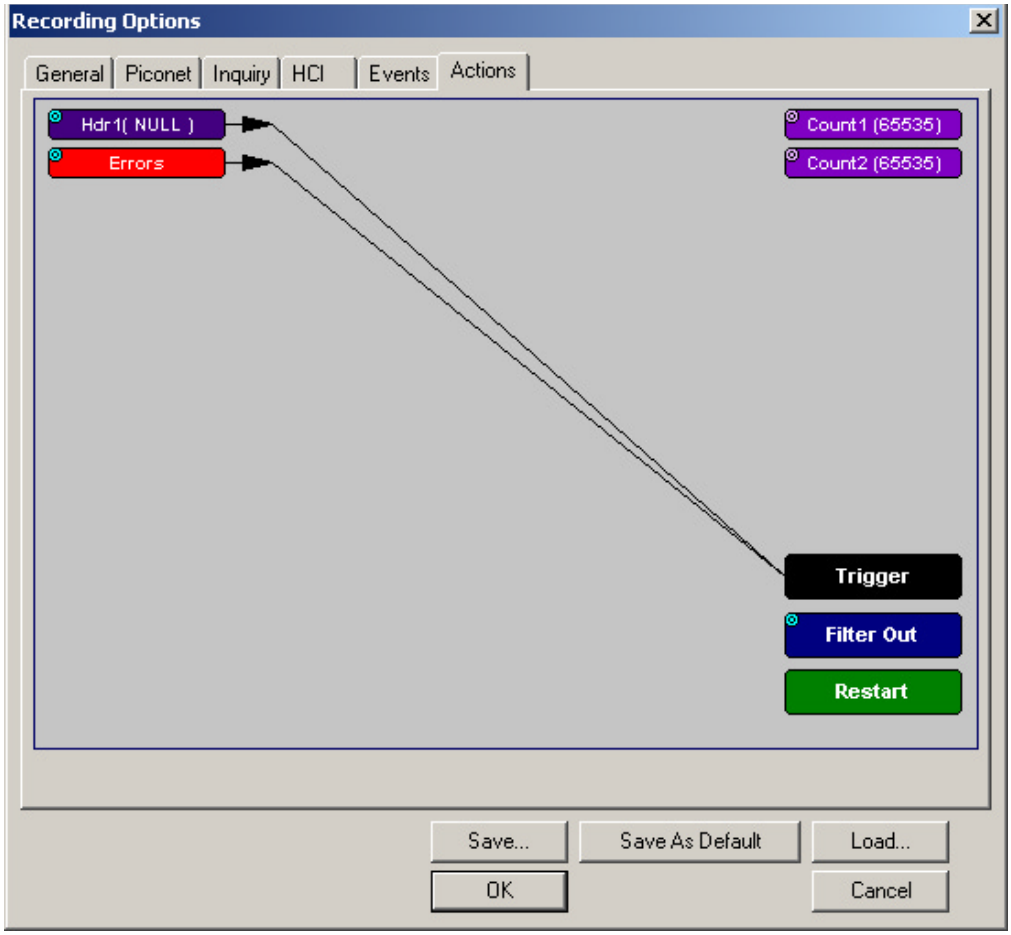
Breakout Board (Edge Triggered)

The following names are derived from pins on the CATC-provided breakout board.

- *TRIG IN* - Selectable Edge triggered inputs. Will trigger on any edge it detects.

6.8 Recording Options - Actions

The **Actions** screen allows you to specify the type of action that Merlin II should perform when it encounters the events specified in the **Events** window.



Action Buttons - Their Functions

The **Action** buttons in the right side of the window provide the means of setting triggers, filters, and restarts. To set an action, you simply drag your mouse from an Event to an Action. As described further on, this movement will link the two via an arrow.

Trigger

The **Trigger** button enables event triggering.

Filter In/Out

The **Filter In/Out** button allows events to be filtered in or out of the recording. Filtering provides a useful method of excluding data from the trace so you can conserve recording memory.

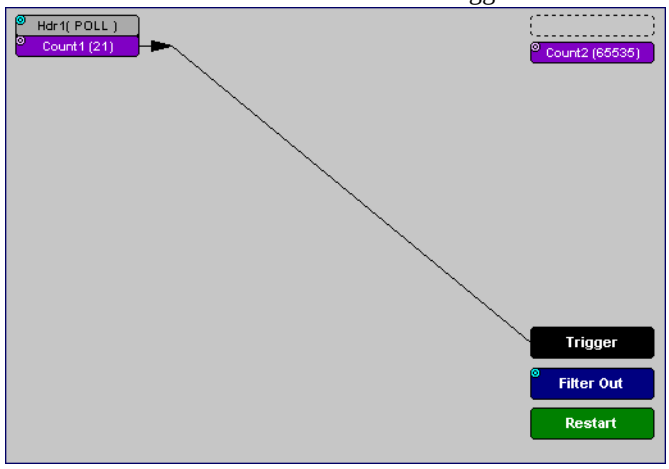
Restart

The **Restart** button causes the two counters Count1 and Count2 to be reset to zero. It also causes the search for *event sequences* to restart. Event sequences are sequences of events that trigger the end of the recording. Restart buttons provide you with a way of saying "If you see a sequence of A, B, C, and D, then trigger. However, if you see *X* anywhere during the sequence, restart your search."

Count1, Count2

Count1 and Count2 are counters for specifying how many events must occur before an event can cause a trigger. Counters allow conditions to be made such as "Trigger after the 21st Poll packet" (see screenshot below).

The Actions window showing a condition based on a Poll packet and a counter. This condition reads "Trigger after the 21st Poll packet."



Connecting Events to Counters

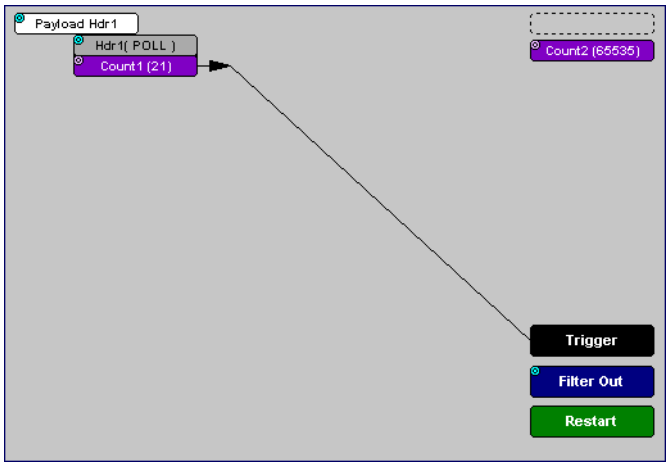
To connect an event to a counter, click an Event button, then click one of the two counter buttons. The Counter will reposition itself immediately below the event. A line will the connect the counter to the Trigger button.

This latter connection between the Counter button and the Trigger button occurs because counters always work in association with triggers. Counters act as assistants to triggers.

Setting Multiple Conditions with Counters

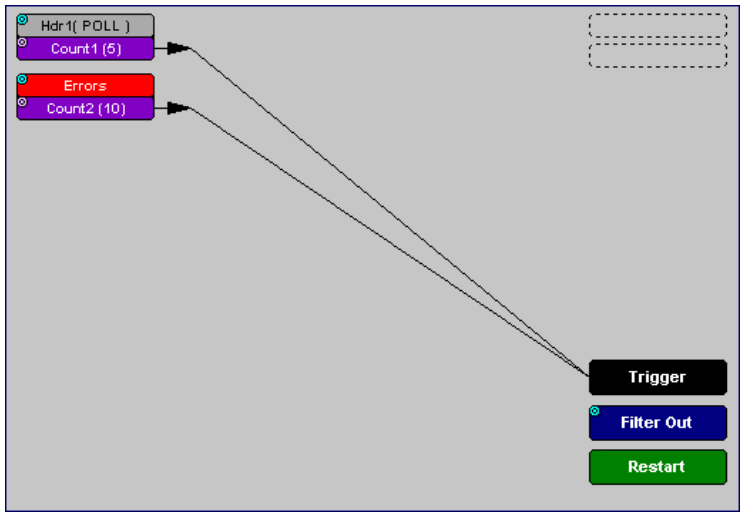
You can create multiple event conditions by linking a counter to multiple events or by linking two counters to two or more events.

Linking Multiple Events to One Counter - When two or more Events are strung together and then connected to a counter, the event button that is touching the counter gets counted. The example below reads "Trigger after you see a sequence of a packet with the specified payload followed by a 21 null packets."



Linking Two Events to Two or More Counters - If an Event is linked to **Count1** and a second event is linked to **Count2**, it creates an "or" statement. This statement reads "Trigger when Count1 OR Count2 has reached their specified values."

This example reads "Trigger when Count1 has counted 5 Poll packets or Count2 has counted 10 errors."



Blue Dot Menus

Count1, **Count2** and a few other buttons in the **Actions** window have blue dots in their top left-hand corners that indicate the presence of context-sensitive menus. These menus let you set the button's values and/or operations. Click the left mouse button on a dot to open the menu.

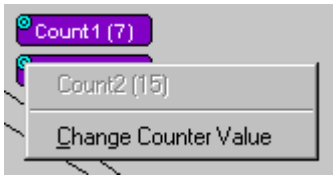
Counters Blue Dot Menu

The **Count1** and **Count2** blue dot menus allow the value of their counters to be changed. The value you specify here tells Merlin II how many instances of an event must take place before a trigger occurs. The counter can be set between 1 and 65,535.

To set a Counter,

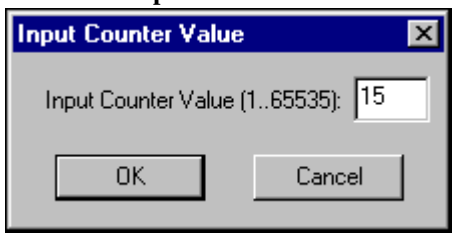
Step 1 Click on the blue dot in the upper left corner of the **Count** button.

You see the **Change Counter Value** menu:



Step 2 Click **Change Counter Value**

You see the **Input Counter Value** menu



Step 3 Enter an input value to tell the Analyzer how many times this event must occur before triggering the end of a recording

Step 4 Click **OK**.

Filter Out/In Blue Dot Menu

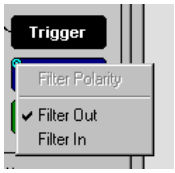
The **Filter Out/In** button toggles between "**Filter Out**" and "**Filter In**".

- **Filter In** records ONLY those packets related to the specified event.
- **Filter Out** records all packets EXCEPT those related to the specified event.

To filter an event in or out of a recording,

Step 1 Click the blue dot on **Filter Out**. (Note: the button may say **Filter In** depending on the last action specified.)

You see the **Filter Out/In** menu:



Use this menu to toggle the selection between **Filter Out** and **Filter In**.

Step 2 Select "**Filter In**".

The button changes to read "Filter In".

Enabling High Pulse, Low Pulse or Pulse Toggle Signal Outputs

Once External Trigger Output has been enabled, you can configure the output signal to one of three formats:

Pulse High - This is the default format. The Pulse High setting causes the Analyzer to transmit a 5 volt, 16.66 nanosecond signal.

Pulse Low - This format causes the Analyzer to transmit a -5 volt, 16.66 nanosecond signal.

Toggle - This format causes the Analyzer to transmit a signal that will toggle with each trigger event between a continuous 5 volt signal and a continuous -5 volt signal.

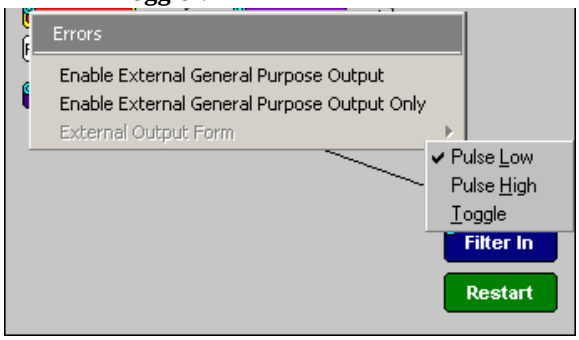
To configure the output signal,

Step 1 Click the blue dot on an Event button that has a small arrow attached to it like the one shown above.

A Blue Dot Menu will open. "**External Trigger Form**" should be a choice available. If it is not, you will need to choose "**Enable External Trigger**" and then reopen the menu.

Step 2 Choose "**External Trigger Form**"

A menu will appear with choices for "**Pulse Low**", "**Pulse High**", and "**Toggle**".



Step 3 Choose an option not currently selected.

The menu closes.

Step 4 Reopen the menu.

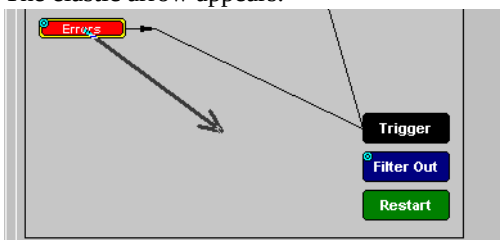
Note that your new selection is now checked.

Elastic Arrow

Elastic arrows allow you to associate Events, Counters, and Actions. To make an association,

Step 1 Click the left mouse button on an Event button such as **Hdr1** or **Errors**.

The elastic arrow appears.



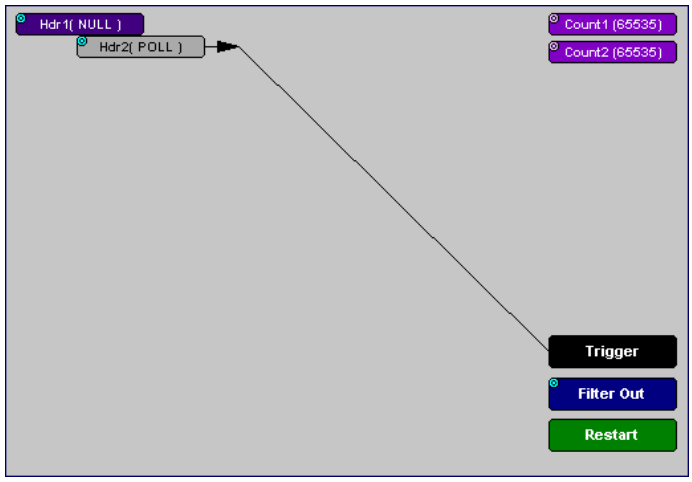
Step 2 Drag the arrow to the desired Action button.

Step 3 With the pointer over an Actions button, click again the left mouse button again.

The arrow is replaced with a black line connecting the Event button to the Action button.

Event Sequencing

If you drag your mouse from one event button to another, you will create a compound condition known as an *Event Sequence*. An event sequence is a condition that says "Trigger when you see the following sequence of packets." The example below may help to clarify.



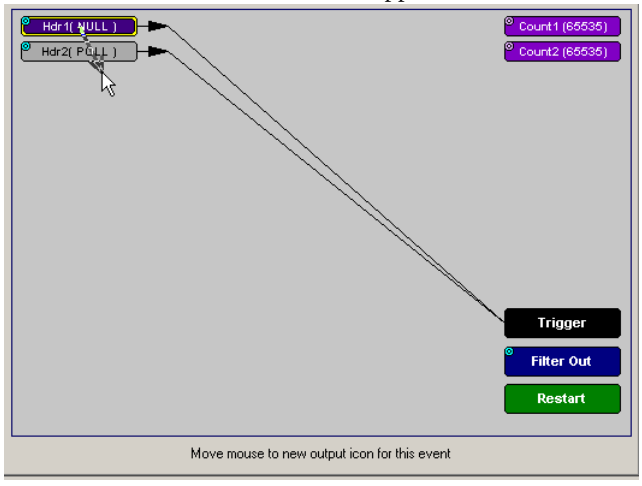
This example means "Trigger when you see a packet with an Null Header followed by a packet with a Poll Header."

To create an event sequence, perform the following steps:

Step 1 Select two events from the Events window

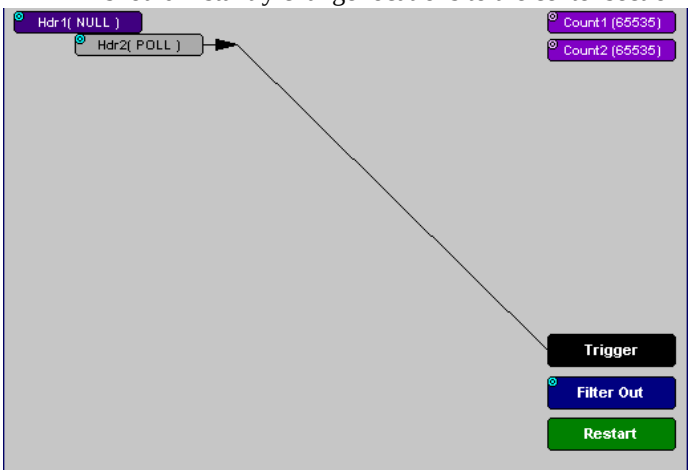
Step 2 Open the Actions window and click on one of the two Event buttons.

An elastic arrow should appear.



Step 3 Click on the other event.

The arrow should connect to the second button and the second button should instantly change locations to the center section of the window.



6.9 Saving Recording Options

To complete your Recording Options settings, use the features at the bottom of the **Recording Options** screen. These features remain the same no matter which of the three Recording Options screens you are working in.

- Click **Save** to save the currently specified Recording Options for use in future recording sessions. Any file name can be specified, though use of the **.rec** is recommended; if no extension is specified, **.rec** is added by default.
- Click **Load** to load a previously saved ***.rec** file, thus restoring a previous set of Recording Options. You can also load the recording options from trace files.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.rec.** Whenever you start up the Analyzer, it automatically loads the **default.rec** file if one exists.
- Click **OK** to apply any changes and close this dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the Recording Options menu.

6.10 Recording Bluetooth Traffic

To start a recording once the appropriate Recording Options have been set,

Step 1 Select **Start** under **Record** on the Menu Bar

OR

Click on the Tool Bar.

Your recording session can continue until it has finished naturally or manually by clicking on the Tool Bar, depending on how you set the Recording Options.

To manually stop recording,

Step 2 Select **Stop** under **Record** on the Menu Bar

OR

Click on the Tool Bar.

Note The manual Stop Recording feature is primarily of use when recording low-volume traffic, which can take a long time to fill the recording buffer.

When the recording is finished, the bus traffic is saved to the hard drive as a file named **data.tfb** or whatever name you assign as the default filename.

If you have enabled the recording is serial HCI traffic from IUT, then a second trace file is created called data_hci.tfb.

To save a current recording for future reference,

Step 3 Select **Save As** under **File** on the Menu Bar.

OR

Click on the Tool Bar.

You see the standard **Save As** screen.

Step 4 Give the recording a unique name and save it to the appropriate directory.

6.11 Taking "Snapshots" during a Long Recording

The Snapshot button allows brief "snapshots" to be taken of traffic as it is being captured into a long recording. This feature provides a way of looking at part of the recording without having to wait for the entire recording to complete. This type of snapshot is different from the one listed on the General page of the Recording Options dialog - that Snapshot refers to a recording of a pre-determined length.

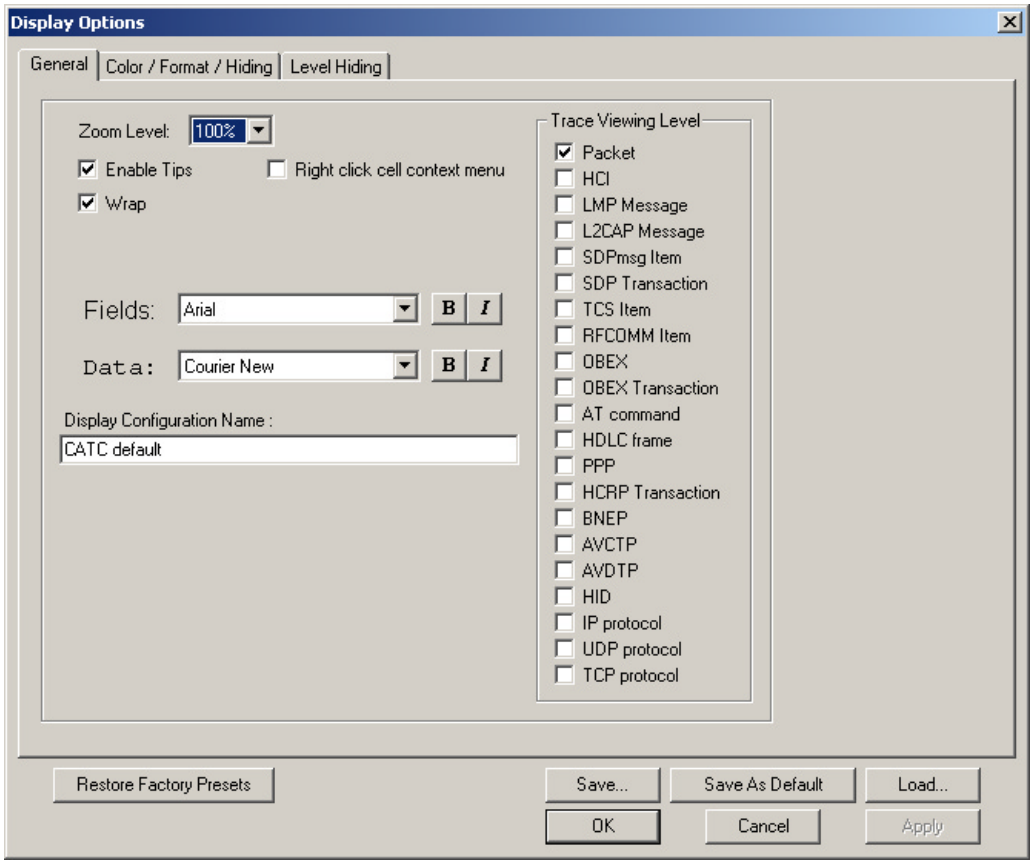
Clicking the Snapshot button during a recording causes the analyzer to open a new, temporary window and display all data from the beginning of the recording to the point at which the Snapshot button was clicked. Subsequent Snapshots will open their own new windows and cause the

analyzer to upload traffic from the end of the previous snapshot to the point at which the Snapshot button was clicked. Snapshot traffic displays in a temporary window. When the recording ends, the entire trace will display in a separate window.

7. Display Options

Use the **Display Options** menu to specify the way CATC Trace information is displayed.

From the **Setup** menu, select **Display Options**.



7.1 General Display Options

Use the General Display Options to specify the basic appearance of a Trace view.

- **Zoom Level**: Adjustable in discrete increments from 10% to 200% percent.
- **Enable Tips**: Select to enable Tool Tips with explanation text to pop up when you position your cursor over various fields in the Trace View.
- **Wrap**: Causes packets to wrap within the window if their length exceeds the width of the window.
- **Right click cell context menu**: Activates the right mouse button for opening cell context menus.
- **Trace Viewing Level**: Allows you to select the hierarchical level at which traffic is displayed.
- **Fields**: Configures the appearance of field text within the trace.
- **Data**: Configures the appearance of data within the trace.
- **Display Configuration Name**: Comment field associated with the ***.opt** file containing the current Display Options values. You can also create and store your unique Display Options for future use.

To create a new Display Options file, follow these steps:

Step 1 Enter a comment for the new file in the **Display Configuration Name** field.

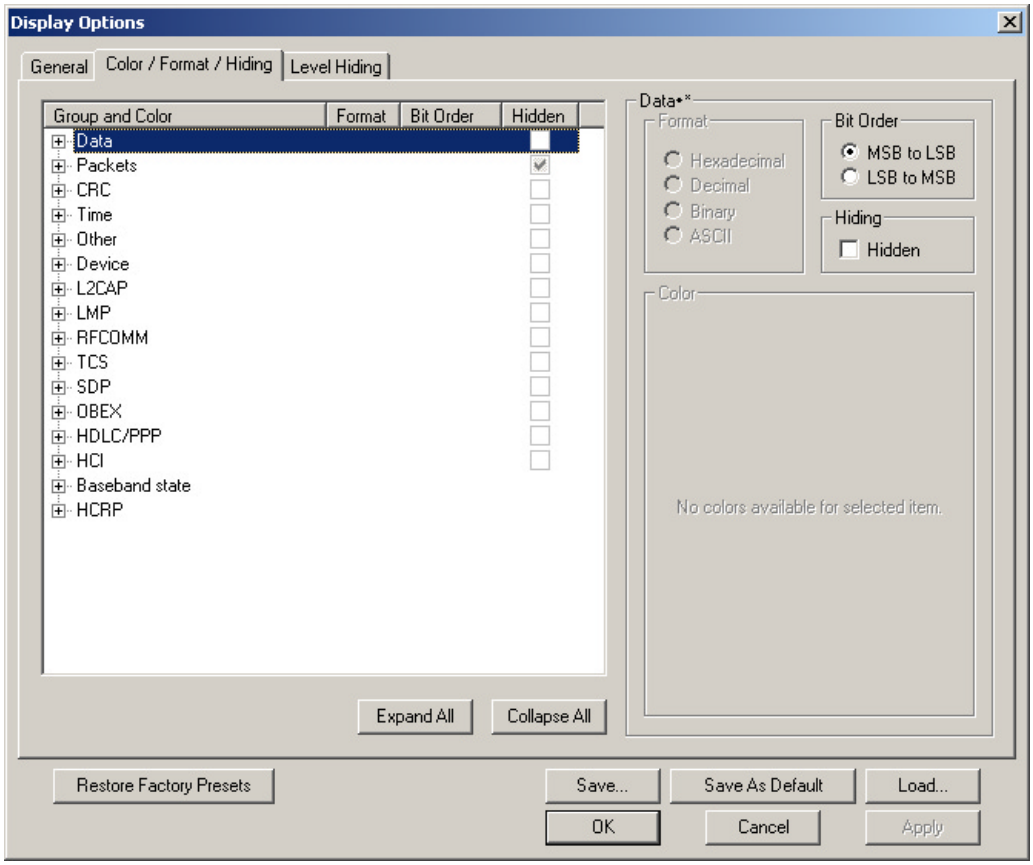
Step 2 Click **Save**...

Step 3 Specify a filename (***.opt**).

Step 4 Click **Save**.

7.2 Setting Color, Formatting, and Hiding Options

Click the **Color/Format/Hiding** tab on the Display Options screen.



Use this window to customize the colors and formats associated with each field in the Trace view. You can also use this window to hide fields within the trace.

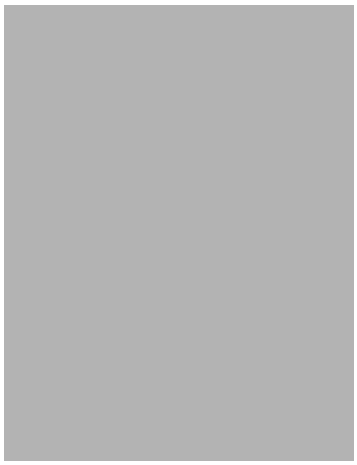
Setting Color Display Options

To change the colors of elements in the trace, select an item in the Group and Color column and use the color pallet screen on the right to make the desired changes.

Note The color of an Invalid Data (packet error) field cannot be changed; it is permanently set to red.

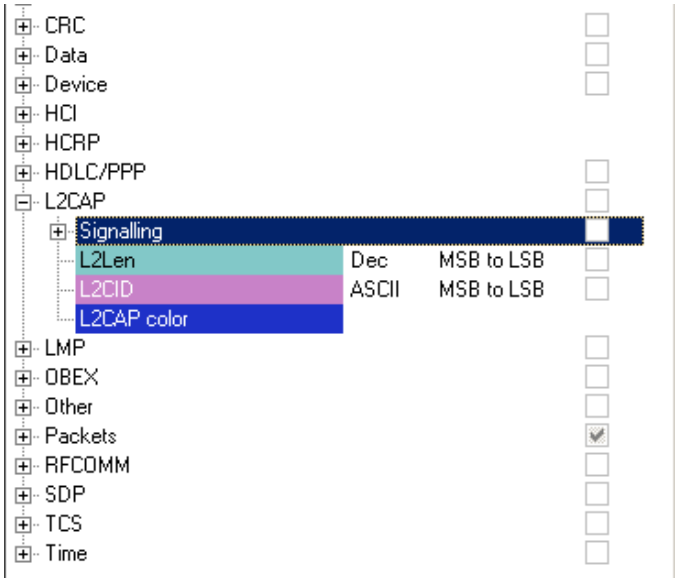
Use this window to customize the colors associated with each field in the trace. You can experiment with these options to achieve the color combination best suited to a particular graphic system.

You can also customize the colors by using the options in the Custom tab.



Changing Field Formats

To change field formats, select an item under the Group and Color column. This action will enable the formats radio buttons on the right. The format types change with respect to the item selected under the Group and Color column. For example, if L2CAP is selected, the following displays:



The following formats are available:

Note Not every format is available for every item.

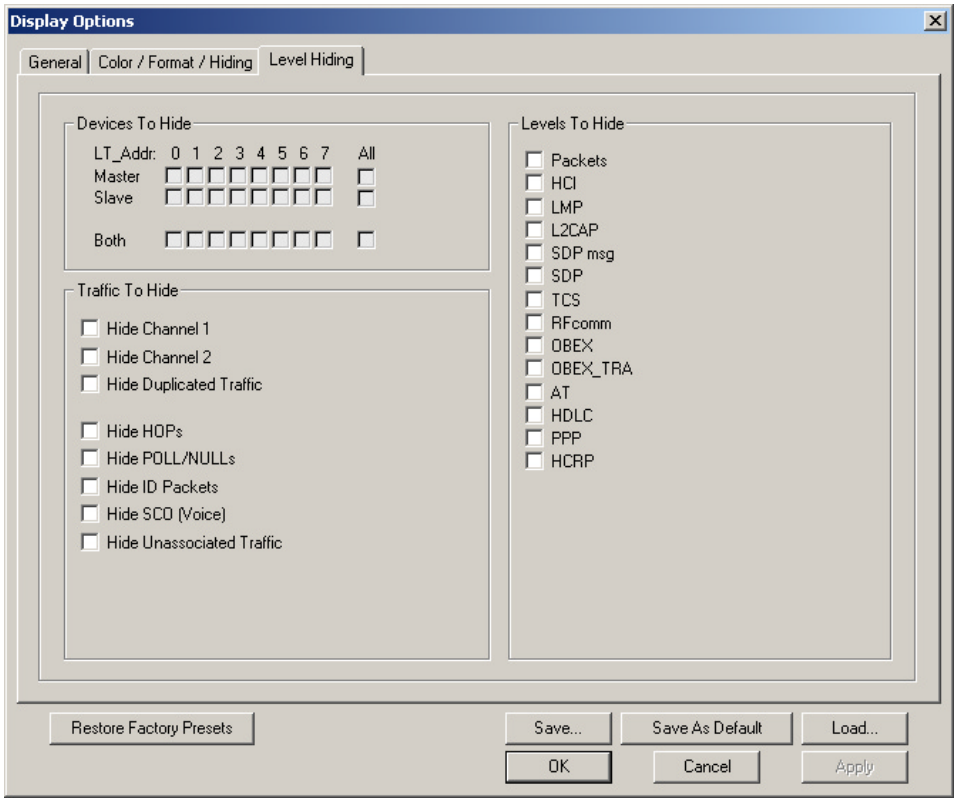
Hiding Display Options

To hide one or more fields in the trace, select the appropriate item from the Group and color column, click the checkbox marked **Hidden**, and click the **Save** button.

You can also hide Sequences from a trace by selecting the desired options from the checkboxes.

7.3 Level Hiding Options

The Level Hiding page allows you to hide various types of traffic. To hide traffic, select one or more items, then click **Save**.



Level Hiding Parameters

Use the Hiding window to hide various fields, packets, messages, and protocols from the Trace View screen. You can modify these settings at will to display a specific area of a Trace.

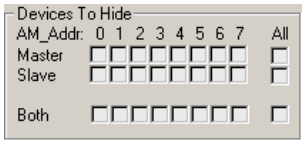
Hiding Fields

The "Hide Fields" checkboxes allow individual fields to be hidden within a trace. Click the checkbox(es) of your choice to hide one or more fields.

Hiding Packets, Messages, and Protocols

The "Hide Packets and Transactions" box contains two grids of checkboxes for hiding whole packets, messages, protocols, and traffic from individual devices. The grids are labeled "Devices to Hide" and "Levels to Hide".

Devices to Hide



The "Devices to Hide" grid lets you hide traffic according to device address. The grid divides into columns which represent different devices.

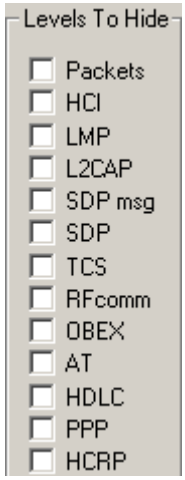
Columns labeled "**0**" through "**7**" and "**All**" represent the **Active Member Address** of a device. By checking one of the boxes in a column, you hide the traffic of the selected device (or traffic from all devices if you have selected **All**.)

The row in which you place your checkmark determines whether you are hiding traffic going to or from a device.

- Master - Hide traffic from a Master to selected Slaves
- Slave - Hide traffic from selected Slaves to the Master
- Both - Hide all traffic between the Master and selected Slave

Example: to hide all traffic from a Master *to* a Slave device with an address of six, click the checkbox under column **6** on the row marked **Master**.

Please note that you can also use the drop-down menu on the "Hide Devices" button to hide or expose devices.

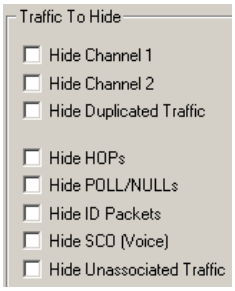


Levels to Hide

The "Levels to Hide" grid divides into rows which represent the different packet, message, and protocol levels. Clicking a checkbox will cause Merlin II to hide all traffic of a selected level.

Traffic To Hide

At the bottom of the Hiding tab of the Display Options window are check boxes for hiding HOPs, POLLs, NULLs, and other kinds of traffic.

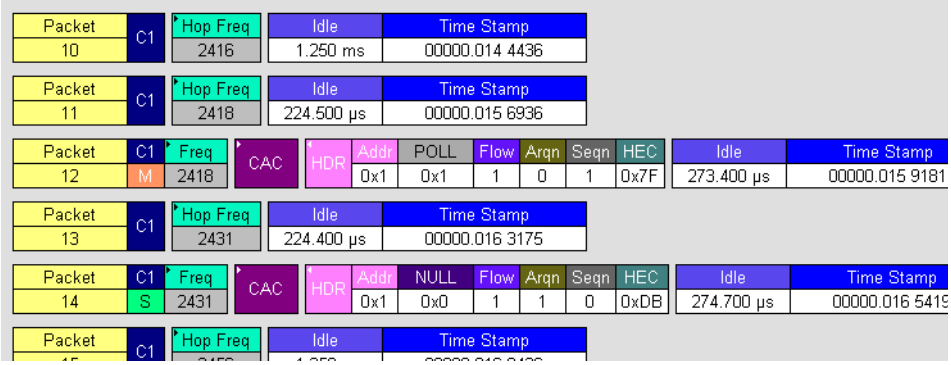


7.4 Saving Display Options

To complete your display options settings, use the features at the bottom of the **Display Options** window. These features remain the same no matter which of the four **Display Options** windows you are working in.

- Click **Save** to save the currently specified display options for use in future sessions. Any file name can be specified, but you must use the **.opt** extension. If no extension is specified, **.opt** is added by default.
- Click **Load** to load a previously saved ***.opt** file, thus restoring a previous set of display options.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.opt.** Whenever you start up the Analyzer, it automatically loads the **default.opt** file if one exists.
- Click **OK** to apply any changes you have made to **Display Options** and close this dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the **Display Options** menu.
- Click **Apply** to apply your changes while keeping the **Display Options** window open.

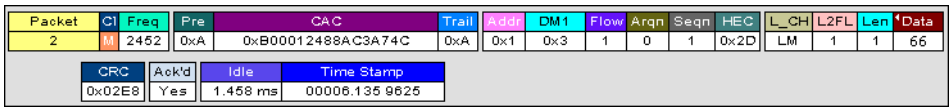
8. Reading a CATC Trace


Packet 10 C1 Hop Freq 2416 Idle 1.250 ms Time Stamp 00000.014 4436
Packet 11 C1 Hop Freq 2418 Idle 224.500 µs Time Stamp 00000.015 6936
Packet 12 C1 M Freq 2418 CAC HDR Addr 0x1 POLL 0x1 Flow 1 Arqn 0 Seqn 1 HEC 0x7F Idle 273.400 µs Time Stamp 00000.015 9181
Packet 13 C1 Hop Freq 2431 Idle 224.400 µs Time Stamp 00000.016 3175
Packet 14 C1 S Freq 2431 CAC HDR Addr 0x1 NULL 0x0 Flow 1 Arqn 1 Seqn 0 HEC 0xDB Idle 274.700 µs Time Stamp 00000.016 5419
Packet C1 Hop Freq Idle Time Stamp

8.1 Trace View Features

- The Merlin II packet view display makes extensive use of color and graphics to fully document the captured traffic.
- Packets are shown on separate rows, with their individual fields both labeled and color coded.
- Packets are numbered (sequentially, as recorded), time-stamped, and highlighted to show the device status (master or slave).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips annotate packet fields with detailed information about their contents.
- Data fields can be collapsed to occupy minimal space in the display (which can in turn be zoomed in and out to optimize screen utilization).
- The display software can operate independent of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.

8.2 Interpreting the Displayed Information


Packet 2 C1 M Freq 2452 Pre 0xA CAC 0xB00012488AC3A74C Trail 0xA Addr 0x1 DM1 0x3 Flow 1 Arqn 0 Seqn 1 HEC 0x2D L_CH LM L2FL 1 Len 1 Data 66
CRC 0x02E8 Ack'd Yes Idle 1.458 ms Time Stamp 00006.135 9625

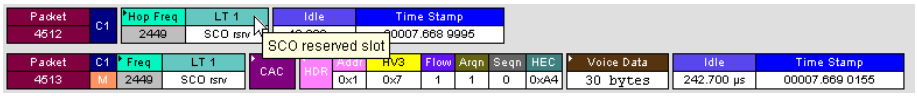
The following table describes some of the abbreviations used in the BTTracer display. Packet #0 is described from left to right:

Packet:#	**Packet/Event Number**
C1/M, C2/S	M =Master Device Transmitting; S = Slave Device Transmitting C1 = Channel 1; C2 = Channel 2
Freq	Current Hop Frequency (in MHz)
Pre	Preamble of the Sync word

Packet:#	Packet/Event Number
CAC	Channel Access Code
Trail	Access Code Trailer of the Sync word
Addr	Active Member Address
DM1	DM1 Packet Type
Flow	ACL Link Flow Control
Arqn	Acknowledgment Indication Flag
Seqn	Sequential Numbering
HEC	Header Error Correction Code
L_CH	LMP Message
L2FL	L2CAP Flow Control Flag
Len	Message Length in Bytes including Opcode
TID	LMP Transition initiated by Master
Opcode	LMP-host_connection_req
CRC	Cyclic Redundancy Check
Ack'd	Packet Acknowledgment based on subsequent packet's ARQN with same LT_ADDR
Idle	Idle Time in nanoseconds
Time Stamp	Decimal in Seconds.Milliseconds.Microseconds*10 This is the analyzer internal clock as a reference with resolution of 100 ns.

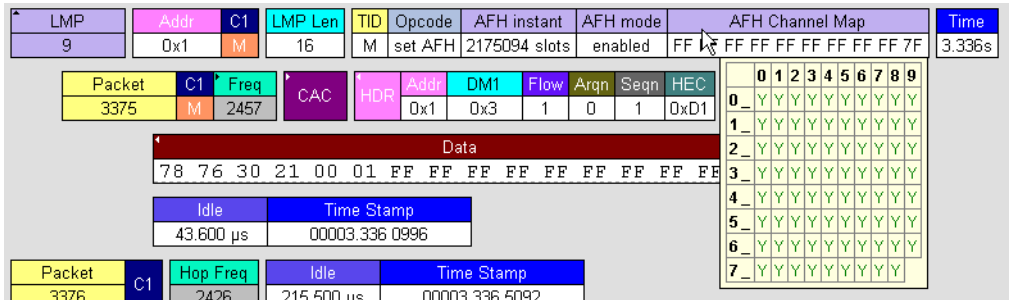
8.3 Timing Analysis

In addition to recording and analyzing the structure and content of packets, Merlin II analyzes time-sensitve operations such as Master-Slave switch, park, sniff, hold, AFH, SCO and ESCO. These events are expected to occur at specific times in the trace. The Merlin II software watches for these events and notes their appearance or absence through the addition of special timing cells to packets within the trace.



8.4 Tooltips

You can get additional information about each field in a trace by holding your mouse pointer over a field. A tooltip will appear with details about the field.



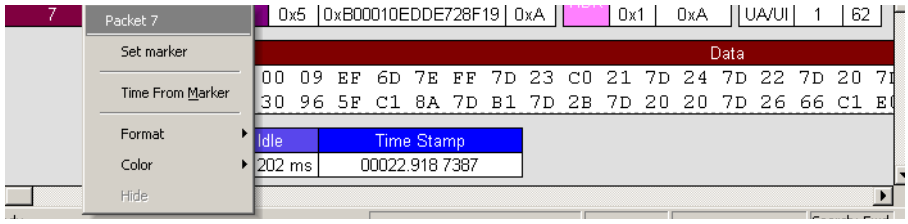
8.5 Set Marker

You can insert a marker while recording using the **Insert Marker** button or can insert a marker after the recording has completed using the **Set Marker** command.

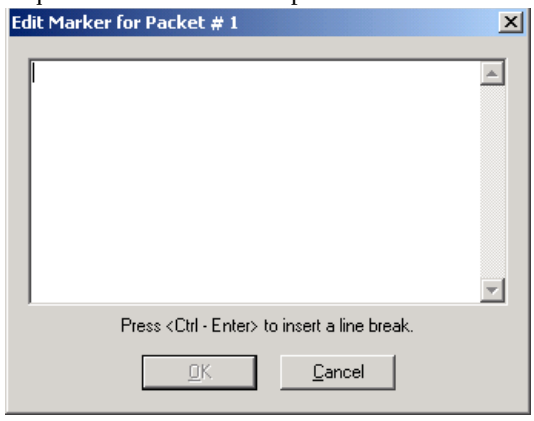
To set a Marker on a packet in a completed trace,

Step 1 Left-click on **Packet #** for the packet you wish to mark.

Step 2 Select **Set Marker**.



You see the **Edit Marker Comment** window where you can enter a unique comment about this packet.:



Step 3 Enter your comment.

Step 4 Click **OK**.

A marked packet is indicated by a vertical red bar along the left edge of the packet # block:

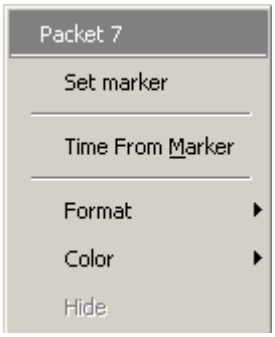
Packet #	T	Freq	Pre	CAC	Trail	Addr	NULL	Flow	Arqn	Seqn	HEC	Time Stamp
1661	S	13	0x5	0xB00010EDDE728F19	0xA	0x1	0x0	1	1	1	0x0B	00060.128 5315

8.6 Edit or Clear Marker

To clear or edit the comments associated with a packet marker,

Step 1 Left-click on **Packet #** for the chosen packet.

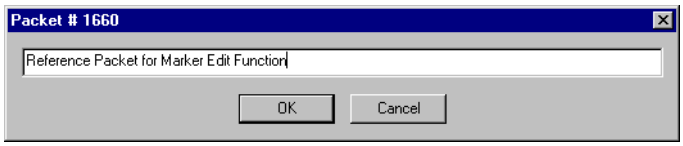
You see the **Packet** menu:



To edit the Marker Comment,

Step 2 Select **Edit marker**.

You see the **Edit marker comment** window:



Step 3 Edit the comment as desired.

Step 4 Click **OK**.

To clear a Marker,

Step 5 Click **Clear marker**.

The vertical red Marker bar disappears.

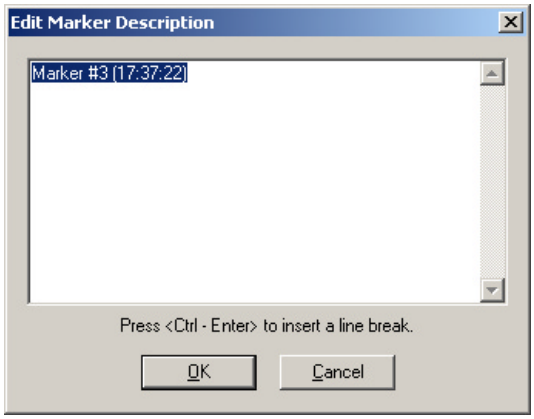
8.7 Setting Markers While Recording

Markers can be inserted into a recording in real time as a way of noting the passage of events such as the powering on or off of a device. By entering Markers during a recording, it becomes easy afterwards to locate events of interest. This is especially useful with large recordings.

To set a marker during a recording,

Step 1 Wait for some key event of interest to occur - like powering off a device.

Step 2 Click the Add Marker button to open the Marker dialog box.



Step 3 Enter text into the dialog.

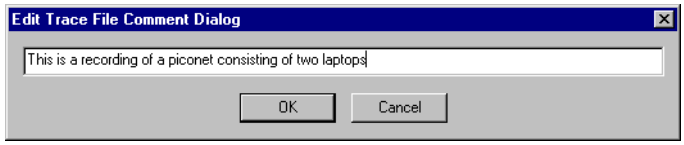
Step 4 The Marker is added to the trace near the time of the event. Afterwards, the marker can be located by selecting **Search** > **Go to Markers** in the menu.

8.8 Adding Comments to a Trace File

You can create, view, or edit the 100-character comment field associated with each Trace file.

Step 1 Select **Edit Comment** under **File** on the Menu Bar.

You see the **Edit comment for trace file** window:



Step 2 Create, view, or edit the comment.

Step 3 Click **OK**.

8.9 Expanded and Collapsed Data Formats

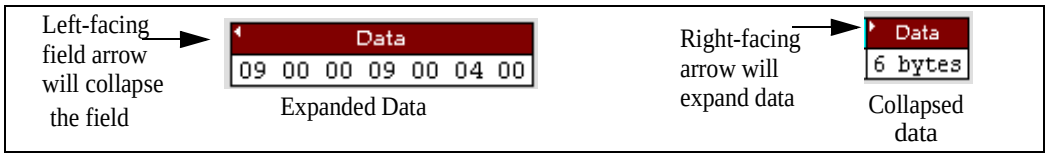
The data field can be expanded to display greater detail or collapsed to a compact view. The Expand/Collapse Data feature operates as a toggle. There are three ways to toggle between the two views.

Double-Clicking

You can expand or collapse a Data field by double-clicking anywhere in the Data field of a packet.

Left-clicking a Field Arrow

Many fields have small arrows in the top left corner. If you left-click this arrow, the field will toggle back and forth between collapsed and expanded views.



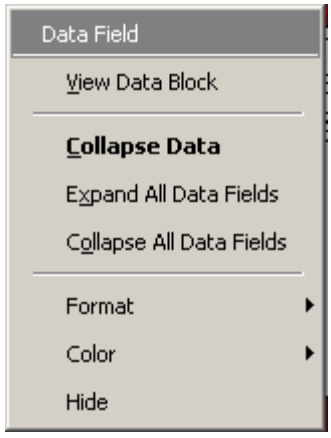
If you click and hold down the left mouse button on one of these arrows, you can collapse or expand the field for *ALL* packets, messages or protocols.

Using the Shortcut Menu

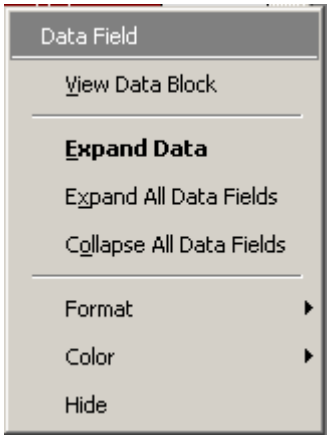
If you left-click on a **Data** field, a menu will open for expanding or collapsing data fields.

Step 1 Left-click on **Data** in the Data packet you want to expand or collapse.

If your Data Trace View is currently expanded, you see the **Collapse Data** menu:



If your Data Trace View is currently collapsed, you see the **Expand Data** menu:



Note that you can choose to expand or collapse

- **Only** the Data in the selected Data packet

  OR

- **All** Data Fields in the Trace View.

Step 2 Select the desired Expand Data or Collapse Data menu item.

The Trace View is repositioned with the selected packet(s) adjusted in the format you have specified.

8.10 Hide Frequency Hops

You can hide Frequency Hops (Hops) from a trace by pressing the **Hide Hops** button on the Tool Bar:

From the Tool Bar

- Click to hide all Hop packets.

8.11 Hide Nulls and Polls

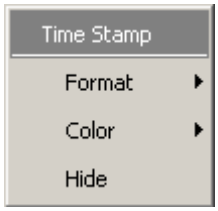
You can hide Nulls and Polls from a trace by pressing the **Hide Nulls and Polls** button on the Tool Bar.

From the Tool Bar

- Click to hide all Nulls and Polls.

8.12 Menus in Clicked Fields

You can display the following menu when you click in a field in a trace.



8.13 Hide Unassociated Traffic

You can hide all traffic that is not associated with the current decode level by pressing the **Hide Unassociated Traffic** button on the Tool Bar.

From the Tool Bar

- First, click one or more decode buttons such as the **View L2CAP Messages** . This button will cause Merlin II to decode the trace and display selected level of decode.
- Next, click to hide all unassociated traffic.

The **Hide Unassociated Traffic** button will cause Merlin II to hide all traffic except for the selected decode messages or protocols. In the example above, all packets would be hidden and only L2CAP messages would display.

8.14 Hide Channel

You can hide all traffic recorded by the channel by pressing . on the toolbar.

8.15 Hide Duplicated Traffic

On two-channel recordings some packets may be recorded by both channels. You can hide duplicated packets by pressing on the toolbar.

9. Searching Traces

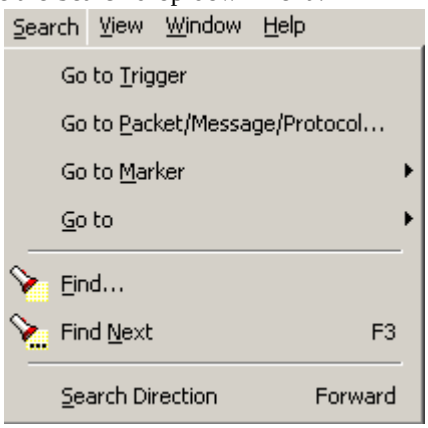
Merlin II has several search commands that enable you to navigate a trace in search of key events such as errors and triggers. These commands are launched from the search menu.

9.1 Search Menu

The Search menu provides several options for searching through recorded traffic, allowing you to find specific packets based on triggering status, packet number, marking, or content.

- Click **Search** in the Menu bar.

  You see the Search drop-down menu:



Go to Trigger

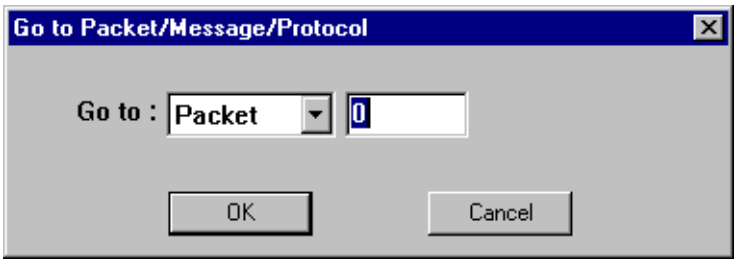
To display a triggering event, select **Go to Trigger** under **Search** on the Menu bar. The **Trace Viewer** display will reposition the trace to show the triggering event at the top of the screen.

Go to Packet/Message/Protocol

To display a specific packet, Message or Protocol

Step 1 Select **Go to Packet/Message/Protocol** under **Search** on the Menu Bar.

You see the **Go to Packet/Message/Protocol** window:



Step 2 Enter the number of the packet, message or protocol you want to display.

Step 3 Click **OK.**

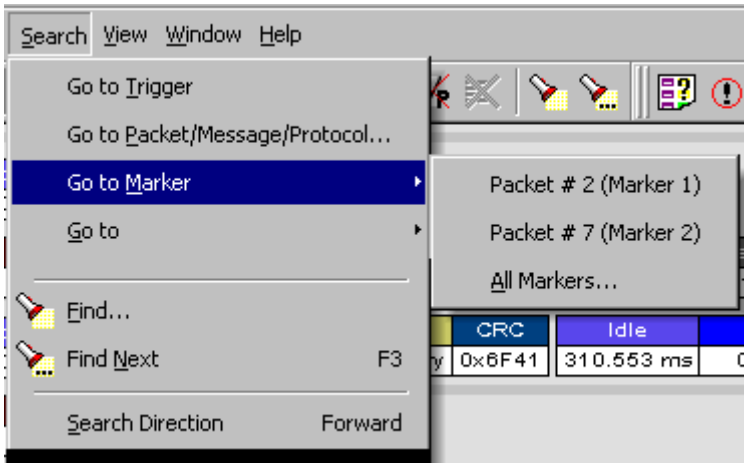
The Trace View repositions to show the packet at the top of your screen.

Go to Marker

To instruct the analyzer to display a marked packet,

Step 1 Select **Go to Marker** under **Search** on the Menu Bar.

You see a drop-down menu listing the marked packets in that Trace View:



Step 2 Select the desired packet from the displayed list.

The Trace View repositions to show the packet at the top of your screen.

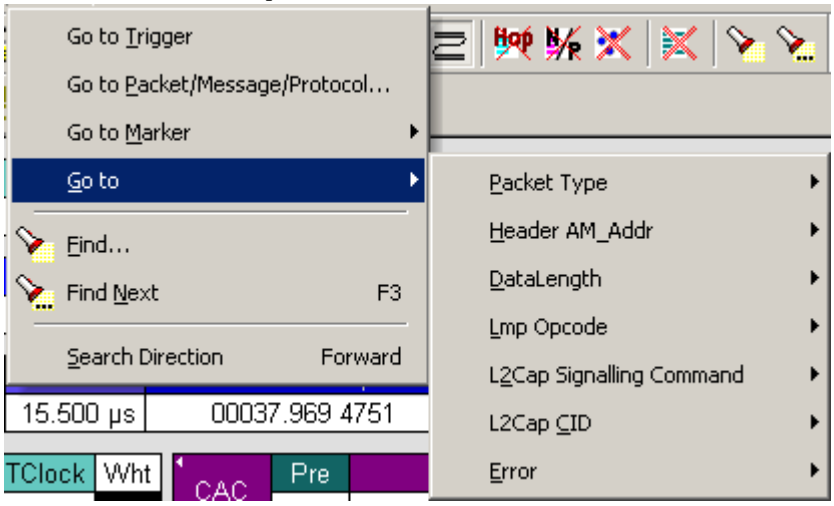
Note The **Go to Marker** feature functions in conjunction with the **Set Marker** feature. The comments within the parentheses following each marked packet are added or edited with the **Set Marker** feature.

Go to

The **Go To** feature takes you directly to an event in a Trace.

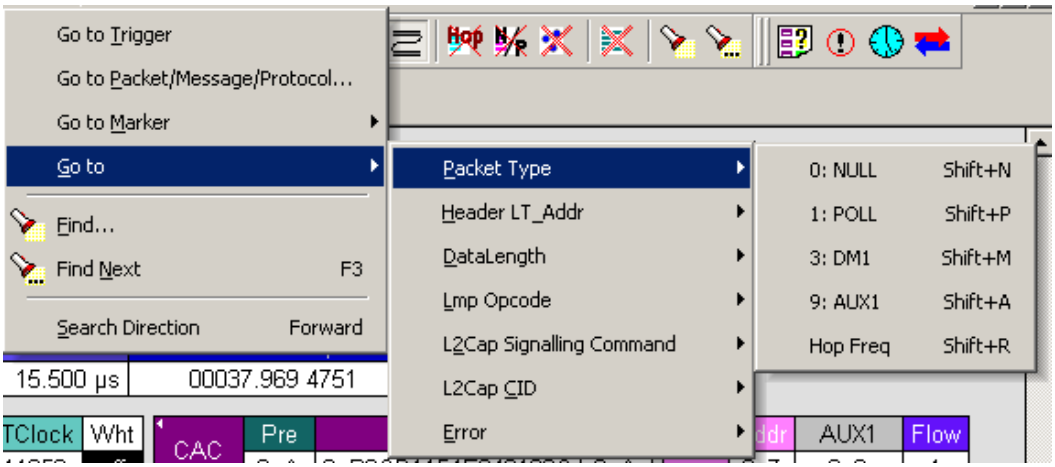
Step 1 Select **Go To** under **Search** on the Menu Bar.

You see the **Go To** drop-down menu:



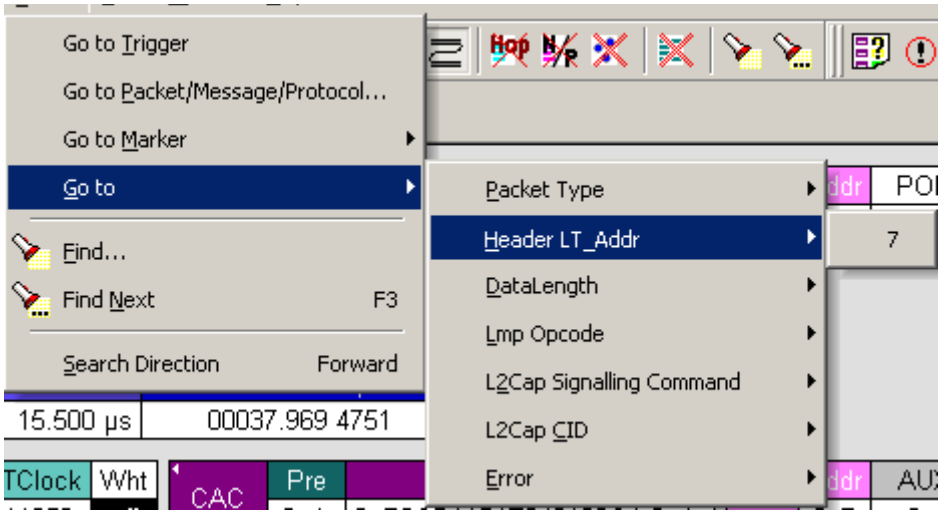
Step 2 Select the event you want to go to and enter the necessary information.

Packet Types



Select the type of packet you want to go to.

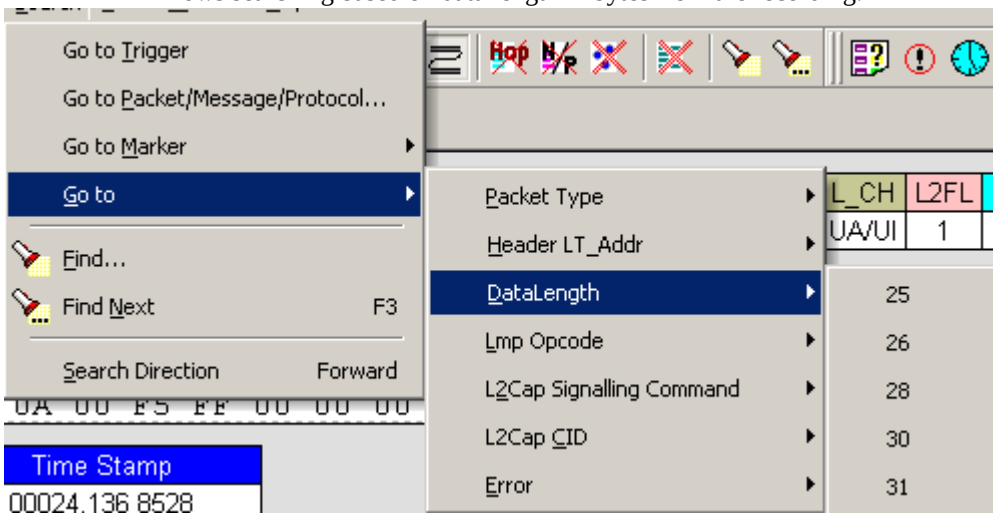
Header LT_Addr



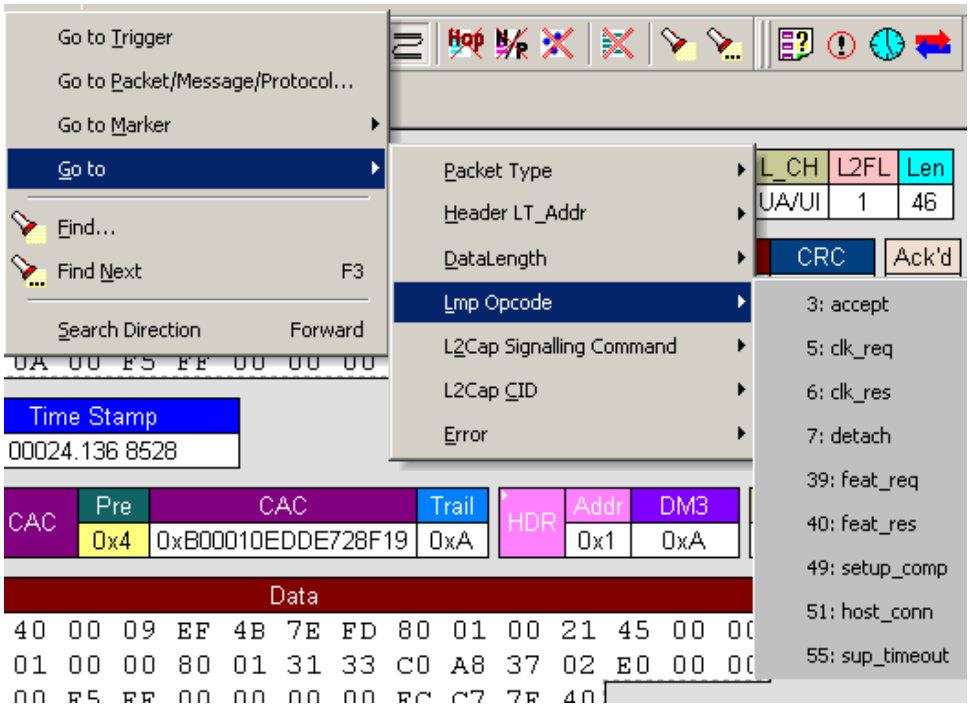
Select an Logical Transport Address from the list.

DataLength

Allows searching based on data length in bytes from the recording.

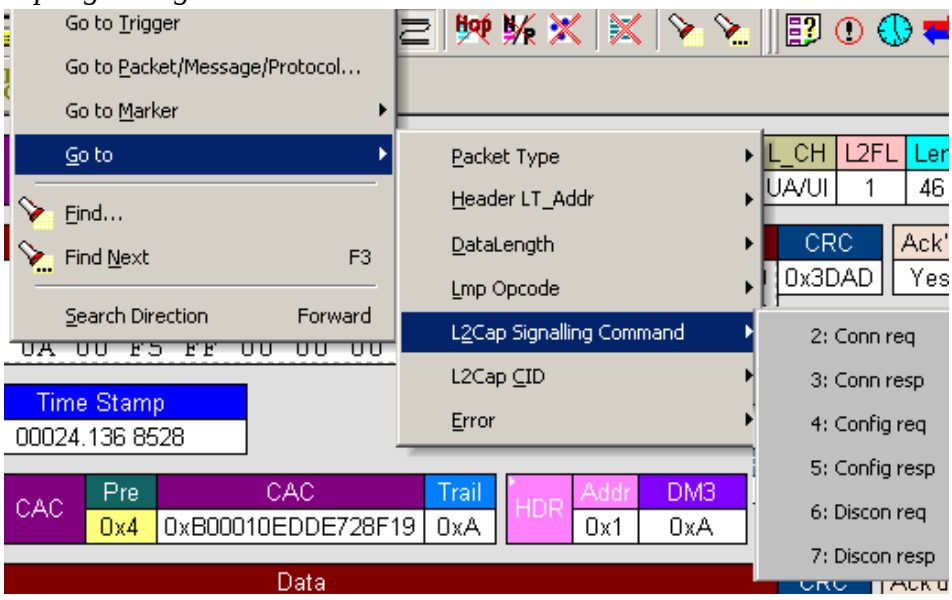


Lmp Opcode



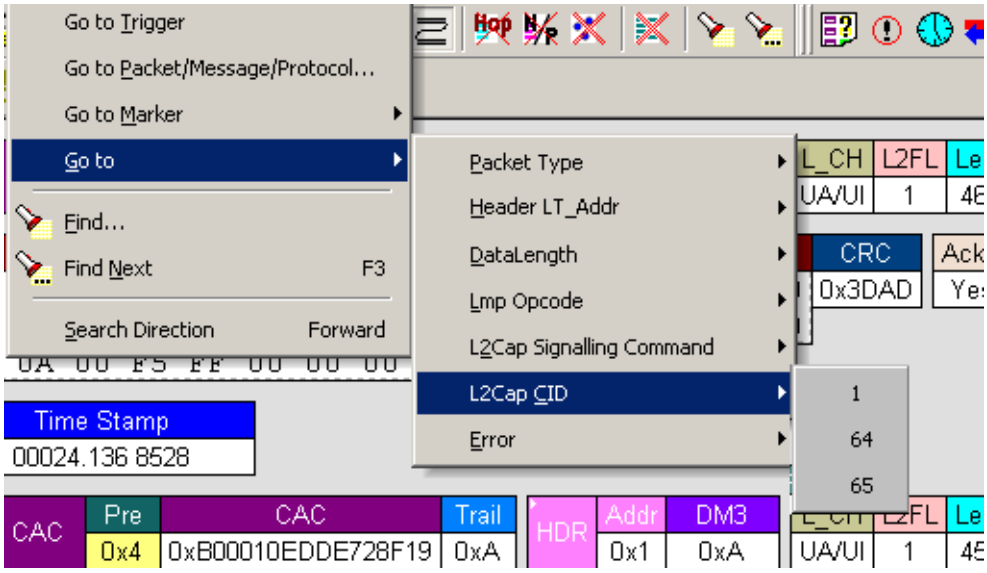
Select the Link Management Protocol Operational Code (Lmp Opcode) that you want to go to.

L2Cap Signalling Command



Select the type of L2Cap Signalling Command that you want to go to.

L2Cap CID



Select the L2Cap Channel ID (L2 Cap CID) that you want to go to.

Error

Moves trace view to next uncorrected error.

Soft Bit Error

Moves trace view to next soft (corrected) error.

Loss of Sync

Moves trace viewer to the next loss of sync.

Find

Find is a utility that allows you to conduct searches of one or more events within a trace. Find allows you to search different hierarchical levels within the trace - packets, LMP Messages, L2CAP messages etc.

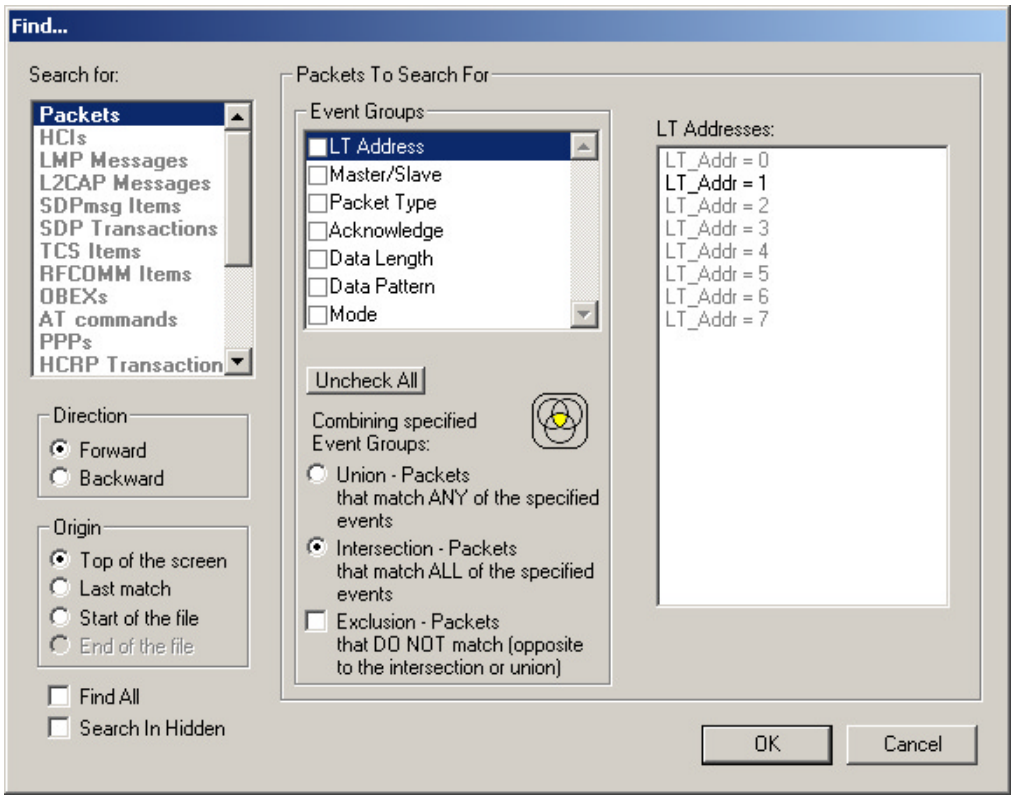
To start find,

- Select **Find...** under **Search** on the Menu Bar

OR

Click in the Tool Bar.

You see the **User-Defined Find Events** screen:



The **Find** window divides into three areas:

Left area -- Controls the search level, search direction and search origin.

Find All - Extracts the results and place them in a separate trace.

Search In Hidden - Searches all packets including packets that have been hidden.

Center area -- Controls the event groups to be searched. The selection you make will display further choices on the right side of the Find window. At the bottom are three options called Union, Intersection, and Exclusion that are used with multi-criteria searches. These options are explained below.

Right area -- Controls the specific events to be searched within the trace. The box in this right section displays events from the selected Event Group.

The right area is context sensitive -- the Event Group selected in the Center area will determine what events will display on the right. For example, if you select **Packet Type**, the Right area will show you a list of packet types. Bold entries in the list represent items that actually occurred in the trace.

In the screenshot shown above, for example, LT Address is selected. On the right, you see that only Address 1 is in bold. This indicates that only a single device was transmitting traffic in the displayed trace.

Event Groups

Event Groups are categories of events that can occur in a trace. Clicking on an Event Group will display a list of Event types on the right side of the Find window that occur within each Event Group.

LT Address

Contains a list of seven Logical Transport addresses. Bold entries represent devices that occur in the trace.

Master/Slave

Contains two options labeled **Master** and **Slave**. Selecting an option will cause Merlin II to search for traffic based on the selected role.

Packet Type

Contains a list of all Bluetooth packet types. If a packet type occurs in the trace, it will appear in bold.

Acknowledge

Contains a list of three Acknowledge types: **Explicit NACK**, **Implicit NACK**, and **ACK.** The three Acknowledge types are responses a device can issue to attempts to transmit packets to it.

A device can send an Acknowledgment in two ways: through setting the ARQN field to 0 (= explicitly not acknowledged), to 1 (explicitly acknowledged) or by sending an empty packet that does not have an ARQN field (= implicitly not acknowledged).

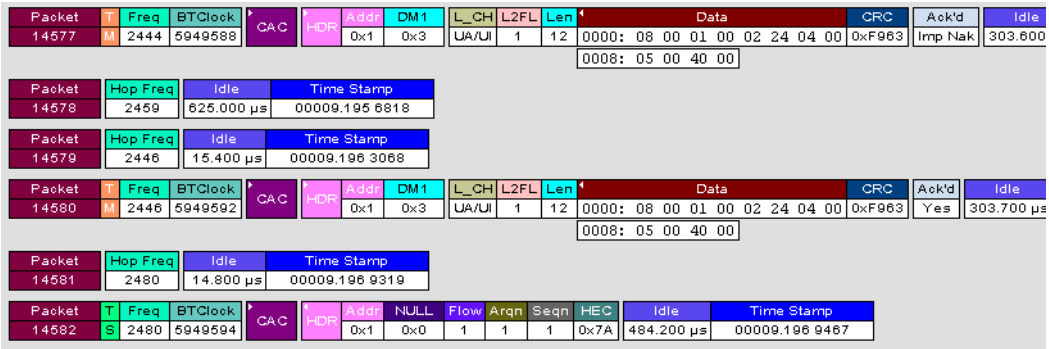
Explicit NACK - Explicitly not acknowledged. An Explicit NACK is an explicit response by a device that it did not receive a data packet. The Explicit NACK is transmitted in the ARQN field (=Acknowledgment Request Negotiation field). ARQN=0 means 'Explicit NACK.'

Implicit NACK - Implicitly not acknowledged. An Implicit NACK is a NACK that is implied rather than explicitly stated. If a device responds to a data packet by sending an empty packet, the NACK is implied.

ACK - Acknowledged. If a data packet is successfully transmitted to a target device, the target device acknowledges the received packet by setting the ARQN field to 1.

Acknowledgments are easily seen in Merlin II traces because Merlin II adds an **Ack'd** field on data packets of the transmitting device. This means that you do not have to hunt through the trace to see if the packet was acknowledged.

The following screenshot shows two examples of Acknowledgments.

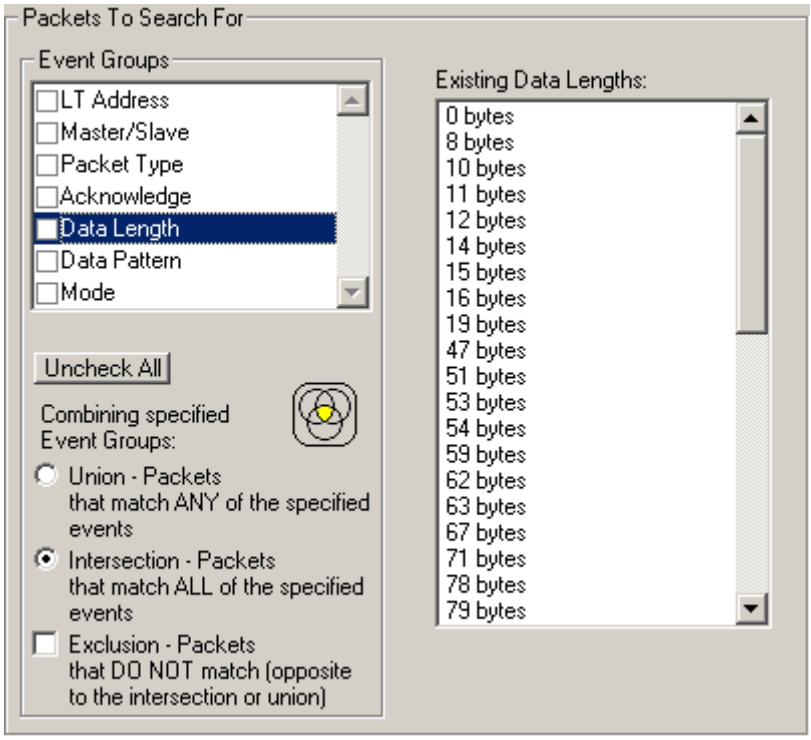

Packet T Freq BTClock CAC HDR Addr DM1 L_CH L2FL Len Data CRC Ack'd Idle
14577 M 2444 5949588 0x1 0x3 UA/UI 1 12 0000: 08 00 01 00 02 24 04 00 0xF963 Imp Nak 303.600
0008: 05 00 40 00
Packet Hop Freq Idle Time Stamp
14578 2459 625.000 µs 00009.195 6818
Packet Hop Freq Idle Time Stamp
14579 2446 15.400 µs 00009.196 3068
Packet T Freq BTClock CAC HDR Addr DM1 L_CH L2FL Len Data CRC Ack'd Idle
14580 M 2446 5949592 0x1 0x3 UA/UI 1 12 0000: 08 00 01 00 02 24 04 00 0xF963 Yes 303.700 µs
0008: 05 00 40 00
Packet Hop Freq Idle Time Stamp
14581 2480 14.800 µs 00009.196 9319
Packet T Freq BTClock CAC HDR Addr NULL Flow Arqn Seqn HEC Idle Time Stamp
14582 S 2480 5949594 0x1 0x0 1 1 1 0x7A 484.200 µs 00009.196 9467

Implicit NACK - Packet 14577 is a data packet sent by the piconet Master device. Packet 14579 should have been a data packet with an acknowledgment. Instead, it is an empty packet. This Master interprets this empty packet as an **Implicit NACK** (i.e., implicitly not acknowledged). Merlin II summarizes this packet exchange by adding an **Ack'd** field to the Master's data packet and setting the **Ack'd** field to **Imp Nak**.

ACK - Packet 14580 is the Master's retransmission of the data sent in packet 14577. Packet 14582 is the reply by the Slave device. This reply contains an ARQN field with a value of (= Acknowledge). Merlin II summarizes this packet exchange by setting the **Ack'd** field on packet 14580 to **Ack**.

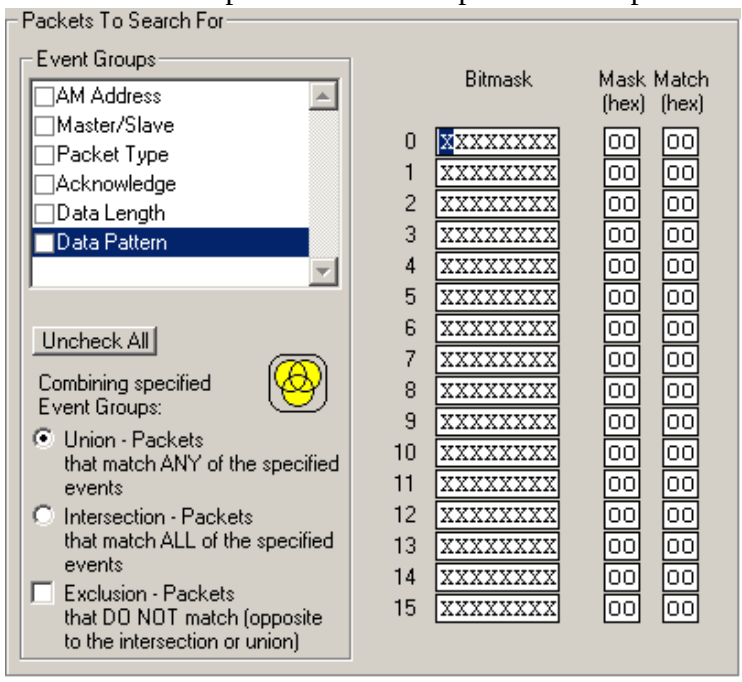
Data Length

Contains a list of all data lengths that occur in the trace.



Data Pattern

Searches for the next packet that has a specified data pattern.



Searching for Bit Patterns

You search for a bit pattern by using the box labeled **Bitmask**. Enter one of the three following values:

- X = 'Don't care,'
- 0 = 'Match a 0',
- 1 = 'Match a 1.'

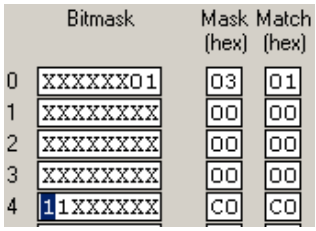
Example -- xxxxxx01 means 'Look for a data pattern where the first 6 bits can be any value but the last two bits must be 01.'

Searching for Long Patterns

You can search for long pattern sequences by entering patterns into multiple rows within the editor. Entering a pattern on one row and skipping several rows before entering the second pattern tells Merlin II to search for the entire pattern between the two specified rows.

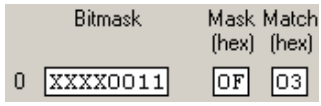
Example - Enter xxxxxx01 in row 1 and 11xxxxxx in row 2. This pattern means 'Look for the pattern xxxxxx0111xxxxxx.'

Example - If you enter xxxxxx01 into row 0 and 11xxxxxx into row 4, it means 'Look for the pattern xxxxxx01 xxxxxxxx xxxxxxxx xxxxxxxx 11xxxxxx.'



Searching for Hexadecimal Patterns

The columns marked Match and Mask allow you to specify a pattern in hex. You enter the pattern you want to match in the column marked Match, and enter the mask in the column marked Mask. The Mask column allows you to specify which bits you are searching for.



Example - A Match of 03 and a Mask of '0F' tells Merlin II that you are looking for the hex pattern of 03 occurring in the last four bits of the pattern. If you enter these values in the Match and Mask columns, the Bitmask section will automatically display the equivalent bit values: XXXX0011.

Union, Intersection, and Exclusion

If you select multiple events, you will need to use the options Union or Intersection to conduct the search.

Union is used to search for any selected event: "Find x or y." Union lets you tell the analyzer to search the trace for any of any of the selected items.

Intersection is used to search for all selected events: "Find x and y." Intersection lets you tell the analyzer to search the trace for any packet having all of the selected events.

Exclusion is used to exclude selected traffic from the trace. Exclusion is used with Union and Intersection --i.e., you select Exclusion with Union or Intersection.

- **Exclusion + Union** -- tells Merlin II to exclude packets with any of the specified events.
- **Exclusion + Intersection** -- tells Merlin II to exclude packets with all of the specified events.

Using Find

Step 1 Select the display level to be searched from the **Search For** box on the left side of the window.

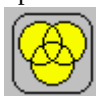
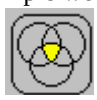
For example, to search through L2CAP messages, select L2CAP. The display level that you select will affect options presented in the Events Group box.

Step 2 Select a search direction and origin.

Step 3 Select one or more events from the **Events Group** box.

Your choices will affect options presented in the box on the right side of the screen.

Step 4 If you have selected two or more criteria, then select either :

- **Union:** Find all packets that match ANY of the specified events. An 
  example would be to find packets with either X or Y.
- **Intersection:** Find all packets that match ALL of the specified events. An example would be to find all packets with X and Y.
  

If you want to selected events from the trace, then select:

- **Exclusion:** Exclude all packets that match any of the specified events. This option works in conjunction with Union and Intersection. Select an exclusion plus one of the other two options. If you select Exclusion and Union, it means Exclude packets in any of the following events. An example would be to exclude packets with either X or Y.

Step 5 Click **OK**.

The search will then occur. Afterwards, the packets meeting the search criteria will display.

Some Find Examples

Search for all DM1 and Poll packets with an Active Member Address of 7.

Step 1 From the Event Group, select **Packet Types**.

Step 2 From the box on the right, select **DM1** and **Poll**.

Step 3 From the Event Group, select **Header LT_Addr**.

Step 4 From the box on the right, select **LT_Addr=7**.

Step 5 From the Center area, select **Intersection**.

Selecting Intersection tells Merlin II to find packets with ALL of the selected traits.

Step 6 Press **OK**.

The trace should reposition to the first DM1 or Poll packet that has an Active Member address of 7.

Exclude all DM1 and Poll Packets with Logical Transport Addresses of 7.

Step 1 Select **Packet Types** from the From the Event Group

Step 2 Select **DM1** and **Poll** from the box on the right.

Step 3 Select **Header LT_Addr** from the Event Group.

Step 4 Select **LT_Addr=7** from the box on the right.

Step 5 From the Center area, select **Intersection and Exclusion**

Step 6 Press **OK**.

The trace will re-display so that it excludes *DM1 packets with LT_Addr=7* and *Poll packets with LT_Addr=7*.

Exclude all packets with ANY of the following attributes: DM1, Poll, or LT_Addr=7.

Step 1 Select **Packet Types** from the Event Groups.

Step 2 Select DM1 and Poll from the box on the right.

Step 3 Select **Header LT_Addr** from Event Group.

Step 4 Select **LT_Addr=7** from the box on the right

Step 5 Select **Union** and **Exclusion**.

Selecting Union causes the analyzer to search for any of the selected events.

Step 6 Press **OK**.

The trace will re-display so that it excludes *DM1s, Polls, or any packet with LT_Addr=7*.

Find Next

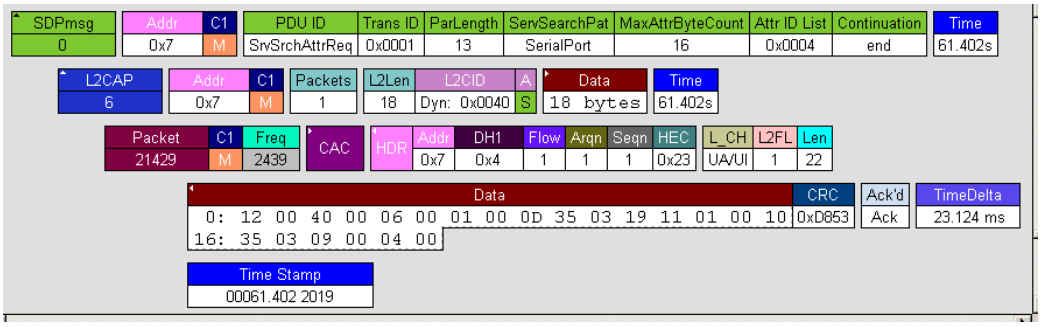
To apply the previous **Find** parameters to the next search,

- Select **Find Next** under **Search** on the Menu Bar

  OR

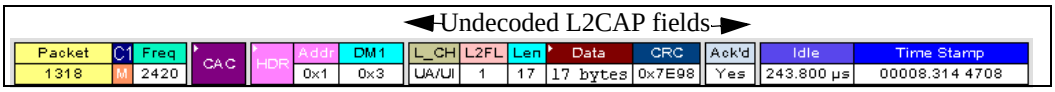
  Click on the Tool Bar.

10. Decoding Protocols



10.1 Introduction

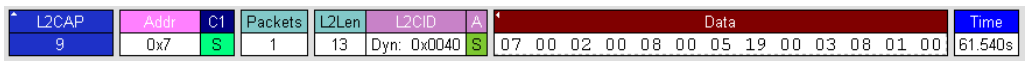
Merlin II can decode HCI, LMP and L2CAP messages, and RFCOMM, SDP, TCS, HDLC, PPP, OBEX, HCRP, BNEP, HID, IP, TCP, and UDP protocols. The default is *packet level* decoding, which means that baseband packets will be displayed when you first view a trace. If these packets are carrying LMP, L2CAP or other protocols, the protocols will display as undecoded fields such as the L2CAP packet below.



By issuing a decode command, Merlin II can decode these LMP and higher fields and display the data in summary statements called *LMP/L2CAP Messages, Protocols Messages, and Protocol Transactions.*

10.2 LMP and L2CAP Messages

LMP and L2CAP Messages are lines in a trace that summarize LMP and L2CAP actions such as an *LMP connection request.* LMP and L2CAP Messages summarize the type of action, the number of packets involved in the action, and the device performing the action. If the message is carrying higher protocol data such as RFCOMM, TCS, OBEX or SDP data, the message displays this data in an undecoded format that can be decoded later.



Undecoded higher protocol data

10.3 Decoding and Viewing Higher Protocol Data

Higher protocol data can be decoded two ways: by clicking a decode button on the toolbar or by selecting a decode command from a pull down menu.

Decoding Via the Decoding Toolbar

The Decoding Toolbar has ten buttons for decoding packets, messages, and protocols:

- **Pkt** (Display Packets)
- **HCI** (Display HCI Protocol)
- **LMP** (Display LMP Messages)
- **L2CAP** (Display L2CAP **M**essages)
- **SDP Msg** (Display SDP Protocol Messages)
- **SDP** Tra (Display SDP Transactions)
- **TCS** (Display TCS Protocol messages)
- **RFCOMM** (Display RFCOMM Protocol)
- **OBEX** (Display OBEX Protocol)
- **OBEX Tra** (Display OBEX Protocol Transactions)
- **AT** (Display AT Commands Protocol)
- **HDLC** (Display HDLC Protocol)
- **PPP** (Display PPP)
- **HCRP** (Display HCRP)
- **AVCTP** (Display AVCTP)
- **AVDTP** (Display AVDTP)
- **BNEP** (Display Bluetooth Network Encapsulation Protocol)
- **HID** (Display HID Protocol)
- **IP** (Display IP)
- **TCP** (Display TCP)
- **UDP** (Display UDP)

For example, to display LMP messages, click

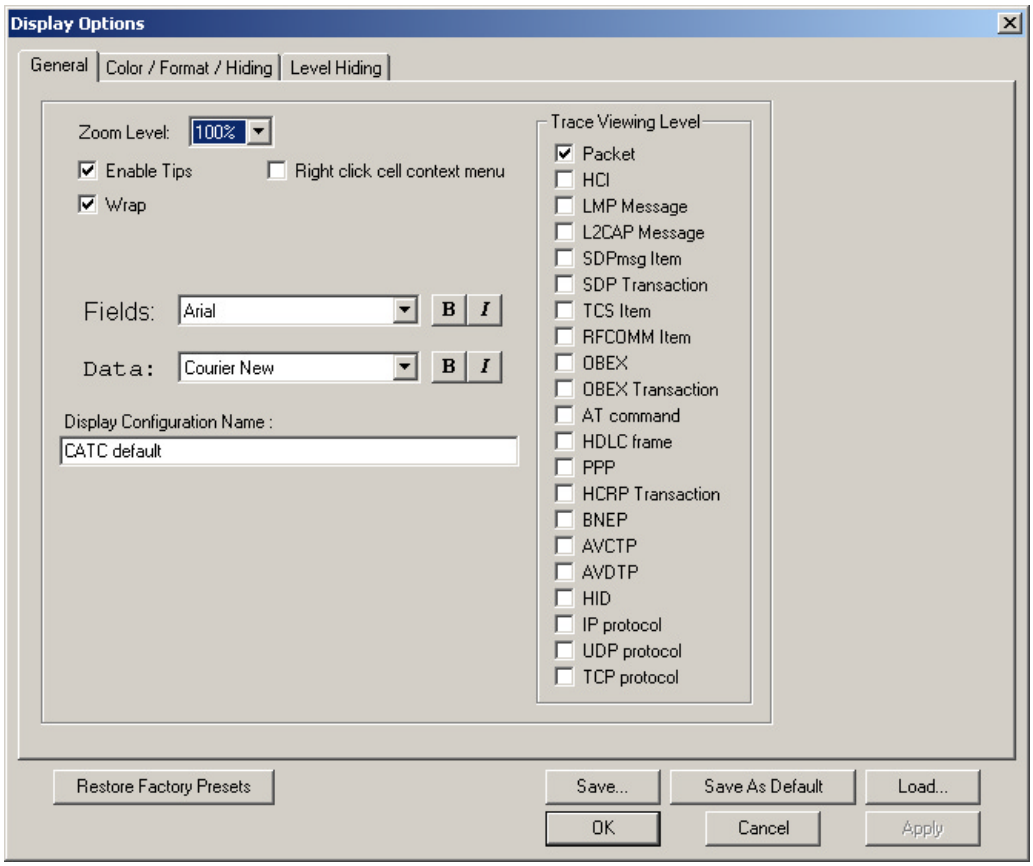
.

Note Once a decode has been performed, it will probably be necessary to scroll through the display to find the decoded messages or protocols. You can shorten your search by first clicking the Hide Unassociated Traffic button .

Decoding Via the Display Options Dialog Box

The Display Options dialog box has three options for issuing decode commands. To issue a command,

Step 1 From the menu bar, select **Setup>Decoding Options**

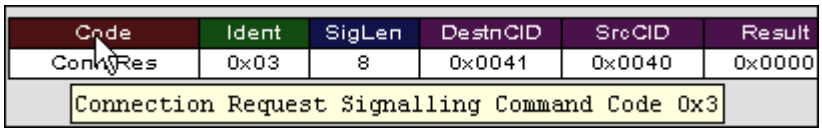


Step 2 Select the option for the desired level of decoding.

Step 3 Click **OK** or **Apply**.

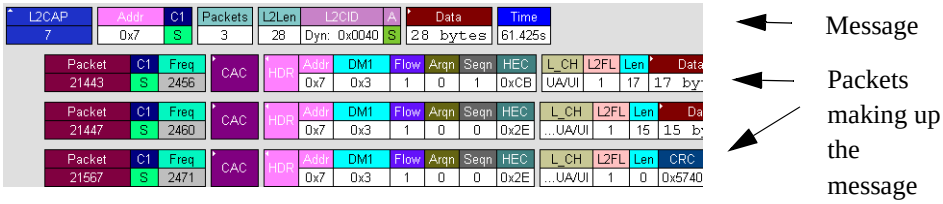
10.4 Tooltips

Additional information about fields can be attained by positioning your mouse pointer over a field of interest. A tooltip will appear that will provide details about the field. In some cases, there can be a considerable amount of information available.



10.5 Viewing Packets in LMP and L2CAP Messages

LMP and L2CAP Messages can be "opened" to reveal their constituent packets by double-clicking the first cell in of the message or clicking once on the small arrow on that same cell. The packets will then display below the message. The following screenshot shows an example of a message and its packets.



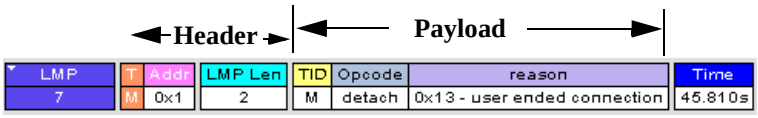
10.6 Types of LMP and L2CAP Messages

If you scroll through a trace, you will see three kinds of message:

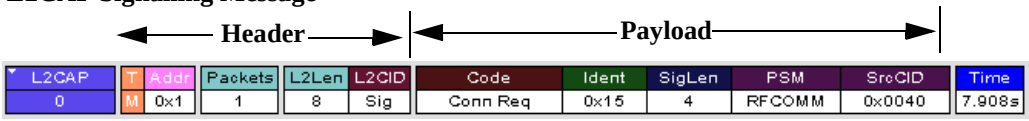
- LMP Signalling Message
- L2CAP signalling Message
- L2CAP Data Transfer Message

Each message has the same basic message header but differs in its payload.

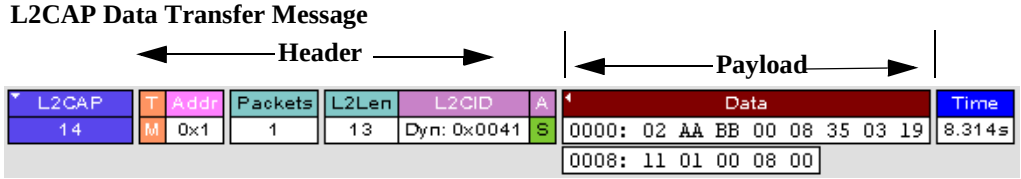
LMP Signalling Message



L2CAP Signalling Message



L2CAP Data Transfer Message



LMP and L2CAP Signalling messages have payloads of commands for establishing LMP and L2CAP channels. L2CAP Data-Transfer messages have a payload that may include RFCOMM, SDP, or TCS data. In order to

view higher protocol data, you will need to decode the messages (shown in the next section). The decoded data will appear as new lines in the trace called "Protocol Messages."

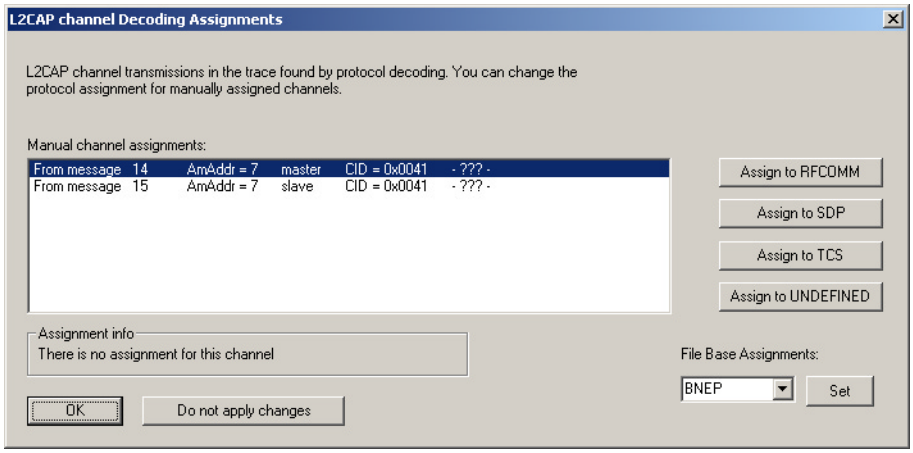
10.7 Viewing L2CAP Channel Connections

Once L2CAP messages have been decoded and displayed, you can check or change their L2CAP channel connections by opening the L2CAP Decoding Connections dialog box.

To view or change an L2CAP channel connection,

Step 1 Select from the menu bar
View>Decoding Assignments

The following dialog box will open.


L2CAP channel Decoding Assignments
L2CAP channel transmissions in the trace found by protocol decoding. You can change the protocol assignment for manually assigned channels.
Manual channel assignments:
From message 14 AmAddr = 7 master CID = 0x0041 - ??? -
From message 15 AmAddr = 7 slave CID = 0x0041 - ??? -
Assign to RFCOMM
Assign to SDP
Assign to TCS
Assign to UNDEFINED
Assignment info
There is no assignment for this channel
File Base Assignments:
BNEP
Set
OK
Do not apply changes

Step 2 Click on a channel assignment and then look at the Connect and Disconnect buttons on the far right of the dialog box.

If the Connect and Disconnect buttons are grayed-out, it means that Merlin II made the channel assignments using data in the trace. You can verify that Merlin II performed the assignments by looking at the text in the "Slave Channel" box in the lower left corner of the dialog box. If you see "Connection Recorded" it means that Merlin II performed the channel assignments.

If Merlin II was not able to make these channel assignments, then the Connect and Disconnect buttons on the right side of the dialog box will be active. You can then assign and edit channel connections.

Step 3 Open the drop-down menu labeled LT_Addr (Active Member Address). If possible, select an address other than the currently displayed address.

The connections for the 'new' device should now display.

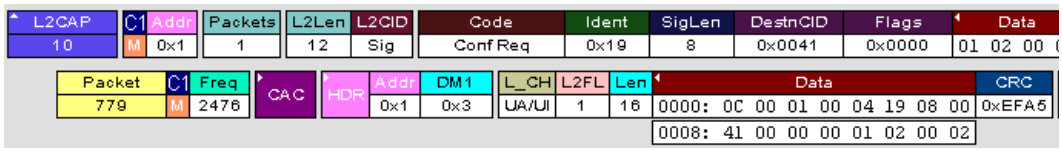
10.8 Viewing Protocol Messages and Transactions

By pressing a button such as SDP Msg or OB EX, you can cause Merlin II to decode the higher level protocol data contained within L2CAP messages and display them as packet-like rows called *Protocol Messages*. Protocol Messages have headers marked "protocol" and fields that vary in appearance and content depending on the type of protocol.

Some Protocol Messages can be grouped into a higher level entity called a *Protocol Transaction*. A Protocol Transaction is a row in a trace that summarizes the higher level protocol data that is transmitted between a Master and Slave device when one sends a request and the other sends back a response. For example, if you press SDP Tra, Merlin II will locate SDP requests and responses between a Master and Slave device summarize their data.

Viewing L2CAP Messages in Protocol Messages

If the protocol heading is double-clicked, the L2CAP data-transfer messages that make up the protocol will display below the protocol. You can also expand the protocol by left-clicking the small downward pointing arrow on the protocol header.



How to Decode

Decoding Protocol messages is the same process as decoding LMP and L2CAP messages.

Using the Toolbar - To decode using the Toolbar, press one of the protocol decode buttons such as: TCS . PPP OB EX .

Using the Menu - To decode using the menu, select:
Setup>Display Options

Then select one of the decode checkboxes.

Once a decode command has been issued, Merlin II will create Protocol Messages in the trace. You will probably have to hide hops, polls, and null packets and then scroll through the trace in order to find Protocol messages.

Expanding Protocol Messages

Protocol messages can be expanded to reveal their constituent packets using any of the following methods:

- Left-click the small downward pointing arrow in the message/protocol header

- Double-click a message/protocol header
- Left-click the message/protocol header and choose "Expand Transaction" from the short-cut menu

10.9 Decoding via the Profiles Toolbar

The Profiles toolbar presents buttons that represent profiles. The Profiles buttons do not represent an additional set of decodes; rather, they represent shortcuts for the existing decodes. By clicking a Profiles button, the analyzer software will automatically depress the protocol buttons needed to decode all of the protocols associated with the selected Profile - for example, RFCOMM, PPP, or IP.

To display the Profiles toolbar, select **View** > **Toolbars** > **Profiles**.

10.10 Changing Protocol Assignments

If a sequence of messages is assigned the wrong protocol, errors will display. To change or remove a protocol assignment, you will need to access the **Assignment** menu and issue an Add Assignment command.

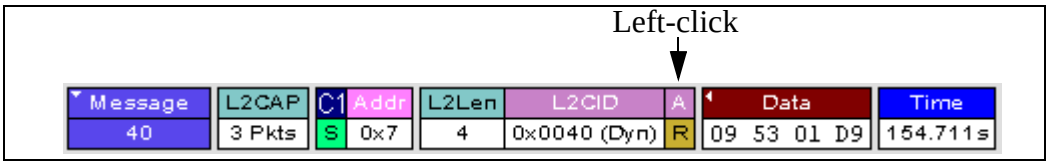
Step 1 Click

to display L2CAP messages.

Note You need to view L2CAP Messages in order to have access to the "**A**" field that permits reassigning protocols.

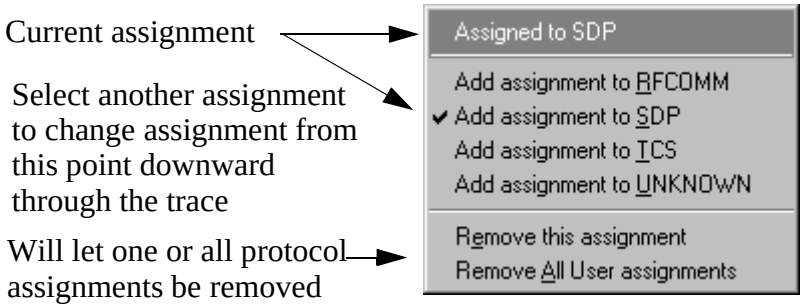
Step 2 Scroll through the trace until you have located an L2CAP message with a field marked "**A**."

Step 3 Left-click the field marked "**A.**"



An **Assignment** menu will open for assigning, re-assigning, or un-assigning protocols to messages. This menu is context-sensitive and will vary in content depending on the protocols in the trace.

The Assignment Menu


Current assignment
Select another assignment to change assignment from this point downward through the trace
Will let one or all protocol assignments be removed
Assigned to SDP
Add assignment to RFCOMM
Add assignment to SDP
Add assignment to TCS
Add assignment to UNKNOWN
Remove this assignment
Remove All User assignments

Step 4 From the menu, select one of the "Add Assignment" options not already selected.

At this point, the protocol assignment will change to your selection.

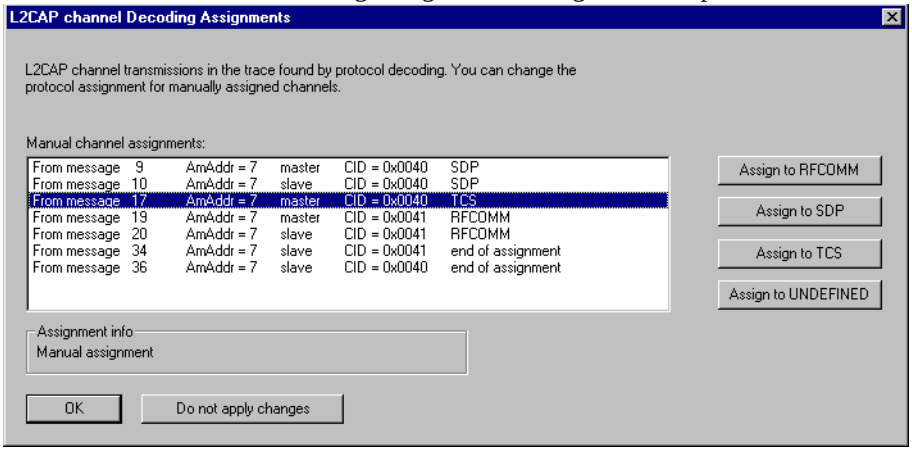
Using the Decoding Assignments Dialog Box

You can get a complete list of all protocol assignments by opening the Decoding Assignments dialog box. This dialog box will tell you which protocol assignments were made by Merlin II and which are user-assigned. User-assigned protocols can be reassigned if need be using this dialog box.

To open the Decoding Assignments dialog box and reassign a protocol,

Step 1 Select from the menu
View>Decoding assignments

The Decoding Assignments dialog box will open. A status message in


L2CAP channel Decoding Assignments
L2CAP channel transmissions in the trace found by protocol decoding. You can change the protocol assignment for manually assigned channels.
Manual channel assignments:
From message 9 AmAddr = 7 master CID = 0x0040 SDP
From message 10 AmAddr = 7 slave CID = 0x0040 SDP
From message 17 AmAddr = 7 master CID = 0x0040 TCS
From message 19 AmAddr = 7 master CID = 0x0041 RFCOMM
From message 20 AmAddr = 7 slave CID = 0x0041 RFCOMM
From message 34 AmAddr = 7 slave CID = 0x0041 end of assignment
From message 36 AmAddr = 7 slave CID = 0x0040 end of assignment
Assign to RFCOMM
Assign to SDP
Assign to TCS
Assign to UNDEFINED
Assignment info
Manual assignment
OK
Do not apply changes

the bottom left corner of the dialog box will indicate who assigned the protocol.

Step 2 Click on one of the displayed assignments.

If the protocol was assigned by Merlin II, the Assign buttons on the right will be grayed out and unavailable. If you want to change these assignments, you will have to use the pop-up menus described in the previous section. If a protocol has been manually assigned by a user, the Assign buttons will become active and allow you to make a change in assignment.

Step 3 If possible, click the appropriate Assign button.

Removing User-Assigned Protocol Assignments

As you practice assigning and reassigning protocols, you will find that one of the more useful commands is "Remove All User Assignments." This command allows you to undo all of your assignments.

To remove some or all user-assigned protocol assignments,

Step 1 Double-click any Protocol Message header to open view L2CAP messages.

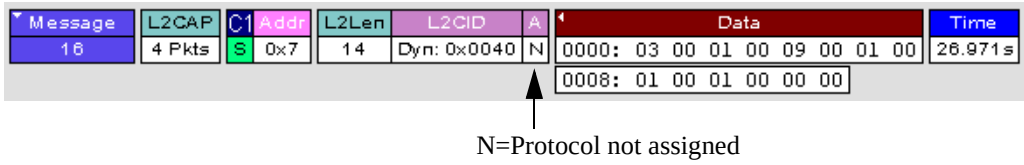
Step 2 Locate a message with a field marked "**A**."

Step 3 Left-click on the "A" field to open the Assignment menu.

Step 4 Select "Remove All User assignments" or "Remove this assignment."

Manually Assigning Protocols

If a recording does not capture the beginning of a dialog between a Master and Slave devices, Merlin II may not have the L2CAP messages it needs to determine the correct protocol assignments. In this case, L2CAP messages will display an "N" in the Assignment field that means "Not Assigned."



An L2CAP message without a protocol assignment for the higher protocol data.

If you know what the protocol assignment should be for the missing assignments, you can manually add them by right-clicking your mouse over the A field shown above and selecting from the pop-up Assignment menu shown on the previous page.

Other Assignments: OBEX Client/Server Status

OBEX messages carry a status that indicates whether the transmitting device is an OBEX client or OBEX server.

To view an OBEX message's client/server status,

Step 1 Open an OBEX trace file such as the sample file "OBEXsample.tfb" in C:\Program files\CATC\Merlin II.

Step 2 Press . , and to hide Hops, NAKs, and unassociated traffic.

Step 3 Press to decode OBEX.

Step 4 Left-click your mouse over the field marked Type.

A pop-up menu will appear indicating whether the message was produced by an OBEX client or server. If the menu items appear

Left-click over the Type field to open the OBEX Client/Server Assign menu.

grayed-out (as they do in this example) it means that Merlin II assigned the client or server status based on data it found in the trace. If the menu items appear in black, it means that the user assigned the status and is therefore free to change the assignment.

Changing an OBEX Client or Server Status

If the beginning sequence of traffic is not recorded in a trace, the client/server status of the transmitting devices will not be preserved in the trace. In this case, the OBEX Client/Server pop-up menu will become active and you will be able to change the assignment.

Decoding BNEP

BNEP (Bluetooth Network Encapsulation Protocol) is a protocol that allows devices to encapsulate network protocols such as IP. Since BNEP can carry different types of network protocols, you need to tell Merlin II what protocol the BNEP is going to be carrying. You do this via a script file called *bnep.dec* that is read during the initialization of the Merlin II software. This file tells Merlin II how to decode BNEP fields. Once read, BNEP can be correctly decoded by pressing the BN EP button on the toolbar. If the decode file is not read at initialization, Merlin II will display the data in an undecoded format.

For more information on BNEP decoding, see a supplemental document on BNEP in the support directory on the CATC web site:

http://www.catc.com/products/support/sup_Merlin II/bluetooth.html

Decoding HID

HID (Human Interface Device) is a profile associated with traffic from devices such as a mouse or a keyboard. To decode HID traffic, you will need to tell Merlin II what types of HID traffic it will be recording. You do this by editing a script file called *hid.dec*. Merlin II reads this file during the initialization of the Merlin II software. This file tells Merlin II how to decode the HID fields. Once read, HID can be correctly decoded by pressing the HID button. If the decode file is not read at initialization, Merlin II will display the data in an undecoded format.

Other Decoding Options

Other decoding options include the following:

- IP
- TCP
- UDP
- AVCTP
- AVDTP
- HCRP

10.11 Encryption

Bluetooth encryption is a multi-staged process that provides devices with secure, encrypted communications. The process begins with a device prompting the user for a Personal Identification Number (PIN). When the right PIN is entered, the Slave begins an encryption setup dialogue with the Master. At the beginning of this dialogue, the Slave and the Master agree on a *Link Key*. A Link Key is a 128-bit value that the two devices use for authentication. When the Slave and Master agree on a Link Key, the Slave then negotiates for the transfer of the *Encryption Key* from the Master device. The Encryption Key is used to encrypt and decrypt messages. Once the Encryption Key is transferred, both devices use it to encrypt all subsequent communications.

In order for Merlin II to decode encrypted traffic, it needs the *Link Key* for each Master-Slave connection for which encryption will be used. If you know the Link Key, you can enter the Key into the Encryption Options dialog box. If you do not know it, you give Merlin II the PIN for a device and allow Merlin II to discover the Link Key on its own. Once Merlin II has the Link Key, it can capture the rest of what it needs by listening to the Master and Slave devices as they negotiate for the Encryption Key.

Note - The encryption settings here are for the Merlin II only. The BTTrainer has its own encryption settings.

Note - There is no need to configure Encryption settings if Merlin II is used to record BT*Trainer* traffic.

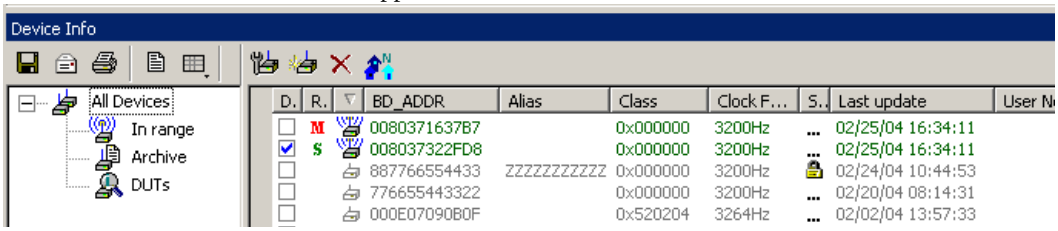
Configuring Merlin II for Encryption

For Merlin II to successfully decrypt traffic, two steps need to be performed: 1) Merlin II needs to be given the PIN or Link Key for each Master-Slave connection; and 2) Recording needs to be begun *before* the Slave connects to the Master. If recording is begun prior to the creating the Master-Slave connection, Merlin II will be able to obtain the encryption key and decode encrypted traffic.

The following steps show how to configure Merlin II for encrypted traffic.

Step 1 Select **View >Device List**

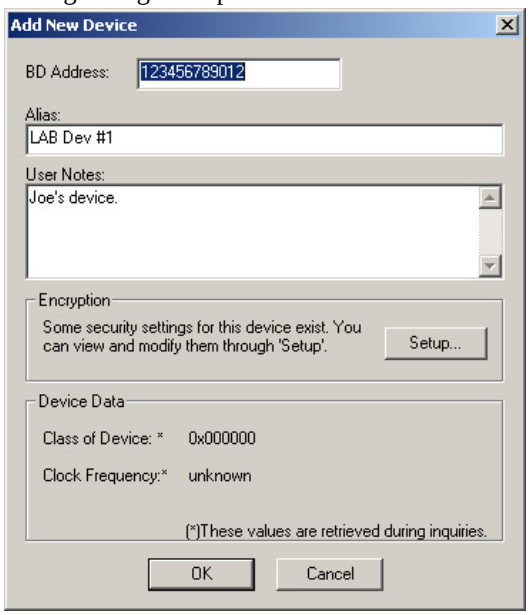
The Device List appears.



Step 2 Click in the row for the device of interest.

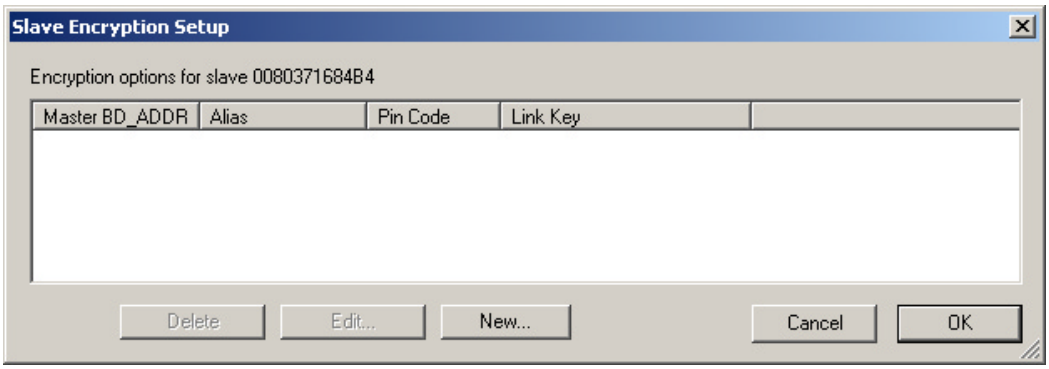
Step 3 Click the Edit Devices button

The following dialog box opens.



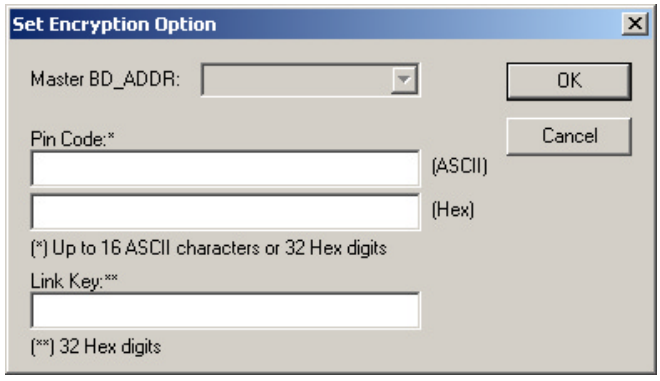
Step 4 Click the **Setup ...** button.

The following dialog box opens:



Step 5 Click the button marked **New**.

The following dialog box appears.



Step 6 Enter the appropriate Personal Identification Number (PIN) for the selected device to the box marked **PIN Code**. This PIN allows Merlin II to learn the Link Key. If you do not have the PIN, skip to Step 5.

Note The PIN you provide should be the same used by the Slave. For example, if your Slave device requires a PIN of "1234", then enter the same PIN in the dialog box shown above.

Step 7 If you do not have the PIN, or if the Master and Slave have already agreed upon the Link Key, manually enter a Link Key as a 128 bit (sixteen byte) hex value into the box marked **Current Link Key**. If you have the PIN, you can skip this step.

Step 1 If the Master and Slave were previously connected, they may already agree on the Link Key. In this case, you will need to provide Merlin II with the Link Key and not simply the PIN.

Step 2 Click **OK**

The changes you have made are applied and the information is displayed in the **Slave Encryption Setup** dialog box as shown previously.

Step 3 Click **OK**.

The **Slave Encryption Setup** dialog box closes. Within the Device List, you should see a "Yes" in the Security field for the selected device.

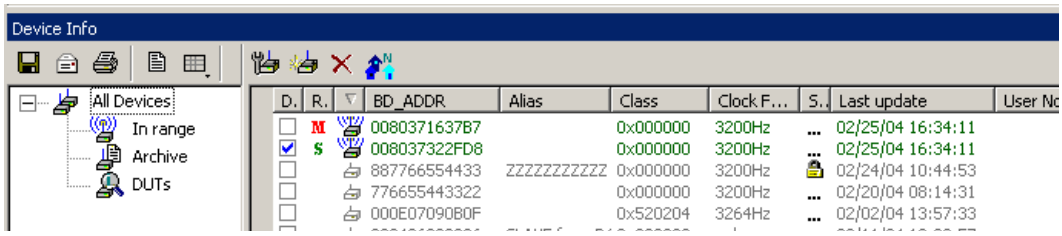
10.12 Re-applying Encryption Settings

If you record a trace with the wrong encryption settings, the trace will not decrypt properly. Merlin II lets you correct the problem by re-applying encryption settings after a recording is finished.

To correct an improperly decrypted trace file, perform the following steps.

Step 1 With the trace open, open the Device List by selecting **View > Device List** from the menu.

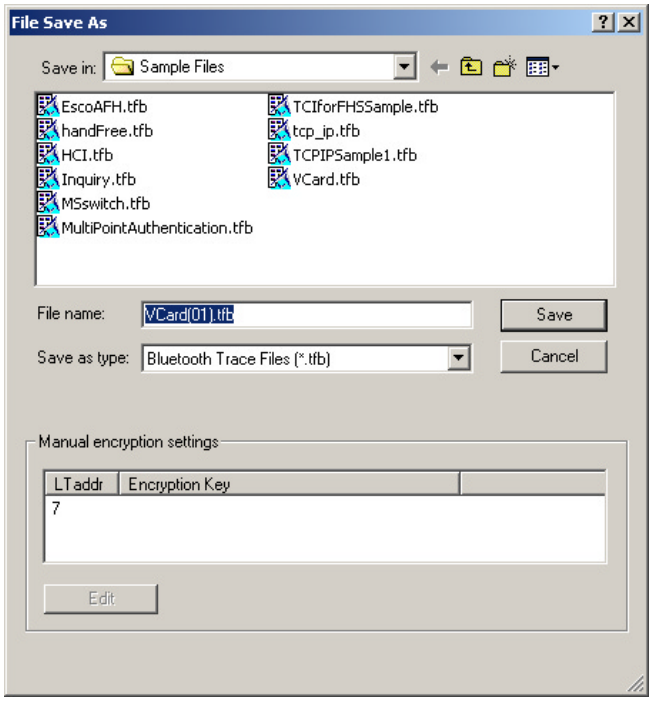
The Device List opens.



Step 2 Follow the directions outlined above in Section 10.11, "Encryption" on page 140 for adding/editing encryption settings.

Step 3 Once the new encryption settings have been applied, run the command **File > Re-apply Encryption Settings ...**

A Save As dialog box opens.



Step 4 Enter a file name (or use the default) and click **OK**.

The file is saved and the new settings are automatically applied. The new file opens automatically.

The file should now be decrypted properly.

Re-applying Encryption On Incomplete Traces

If your trace does not capture the authentication procedure, there will be no way for the analyzer to determine the BD Address of the Slave device. Accordingly, the software will not be able to decrypt the trace file.

If you are using a development kit and already know the BD Address of the Slave device and the Encryption Key, you can enter it manually in the Save As dialog box shown above.

Note LMP_start_encryption_req still has to be present in the trace in order to manually correct the settings.

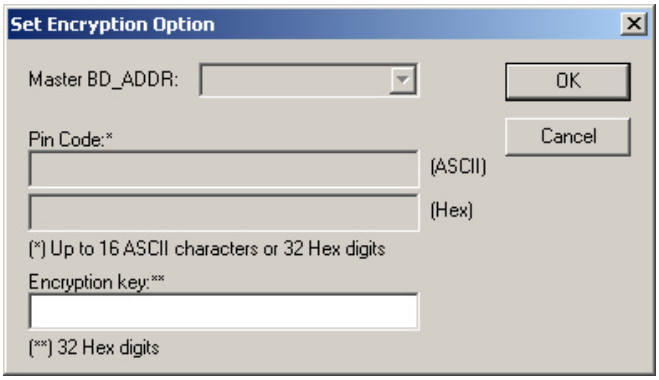
Step 1 Select **File** > **Re-apply Encryption Settings**.

The Save As dialog opens (shown on preceding page.)

Step 2 Select the LT Address for the device whose traffic you are trying to decrypt.

Step 3 Click the **Edit** button.

Step 4 The **Set Encryption Options** dialog box opens.



Step 5 Enter the BD Address and Encryption Key.

Step 6 Click **OK**.

The dialog box closes.

Step 7 Click **Save**.

The dialog box closes and the traffic is decrypted according to your settings.

11. Reports & Exporting Data

Merlin II has several utilities for producing statistics and graphs and for exporting data to files.

Reports include Device List, File Information, Error Summary, Bus Utilization, Timing and Bus Usage Calculation, Traffic Summary and Real Time Statistics.

Trace data can be exported to three formats: text, .csv (a format suitable for spreadsheets and database applications), and, if audio data is present, various audio formats.

11.1 Combining Report Windows

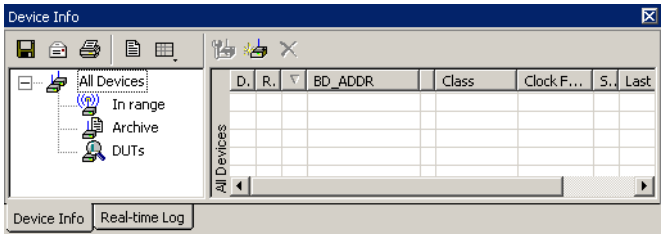
A convenient feature of all report windows is their ability to be combined into a single, multi-page window. When windows are combined, tabs will appear at the bottom of the report window allowing you to switch between pages.

To combine report windows,

Step 1 Open a report window such as Real Time Statistics or Real-Time Log by clicking on the appropriate buttons on the toolbar.

Step 2 Anchor the report window (if not already anchored) by double-clicking on the report title bar. When anchored, the right and left edges of the report window will be formed by the edges of the Merlin II application window.

Step 3 Open additional report windows. The new windows will automatically merge into the first window. At the bottom of the window will appear tabs (shown above) for navigating between the report pages.

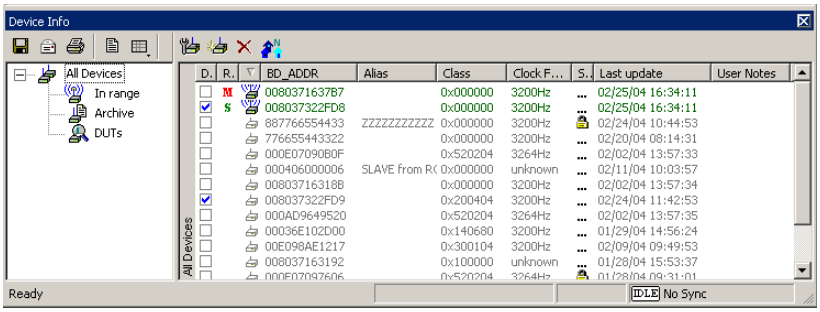


11.2 Device List

Device List describes devices discovered in a previous inquiry or devices entered by the user.

You open Device List by selecting **View > Device List**.

The list is stored in a file that is updated from one session to the next.



By default, Device List appears at the bottom of the Merlin II window.

Importing Device Lists

You can import information about devices that already exist in the Device List or are not listed through the **Import Device List** command.

To import a Device List, run the command
File > **Import** > **Device List**, then select a Device List file from the dialog.

Device Lists can be imported from any PC running a CATC Bluetooth analyzer. While in the **Import Device List** dialog box, you can browse to any PC on your network. If the PC has a CATC Bluetooth analyzer attached, the Device List can be loaded.

Device Lists are created automatically by Merlin II during its operation and stored in the CATC\Shared directory (for example, C:\Program Files\CATC\Shared).

Fields in the Device List

- **DUT** -- Device(s) Under Test. Presents checkboxes for identifying devices you want to appear in a separate Device List window. This option is useful if the Device List has large numbers of entries and you only wish to work with a sub-set of the list. To see how it works, select a few DUT boxes, then click on the the DUT branch on the left side of the window. A copy of the Device List window will open showing only the selected devices.
- **RO** -- Identifies the Master and Slave devices selected in the Recording Options dialog box. Selected entries appear as **M** (Master) or **S** (Slave).

- **State** -- Device State
- **BD_ADDR** -- Bluetooth Device Address
- **Alias** -- Whatever alias you entered for the device in the Add New Device dialog
- **Class** -- The device class for each listed device
- **Clock Freq** -- Shows the device's Clock Frequency
- **Security** -- If Encryption is enabled, then this field will be marked with a "Yes." You enter Encryption by clicking the Add Devices button, and then clicking Options
- **Last Update** -- Shows when device information was last updated
- **User Notes** -- User comments. You add notes by clicking Add Devices and entering text into the dialog box

Buttons

Edit Device -- Opens a dialog box for editing the device settings in the Device List.

Add New Device -- Opens a dialog box for adding new devices to the list. (You can also enter devices by performing an Inquiry.) This dialog box lets you enter information that will appear in the device list: device names, addresses, aliases, and comments.

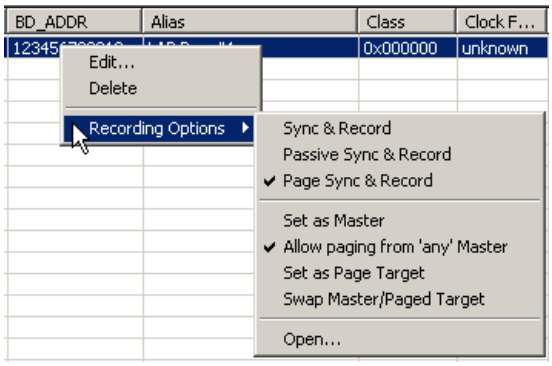
Remove Device -- Removes the selected device from the Device List.

Double-clicking

Double-click any device list entry to get detailed property information. Double-clicking on the Security column of a specific device accesses the encryption settings of that device.

Pop-Up Menu

Right-click in the Device List to open the following pop-up menu:



Edit - Allows Device List entry to be edited

Delete - Deletes Device List entry

Recording Options - Opens sub-menu with options for setting the synchronization method and for setting the Master/Slave addresses for the selected Device List entry:

Sync & Record

Allow paging from 'any' Master

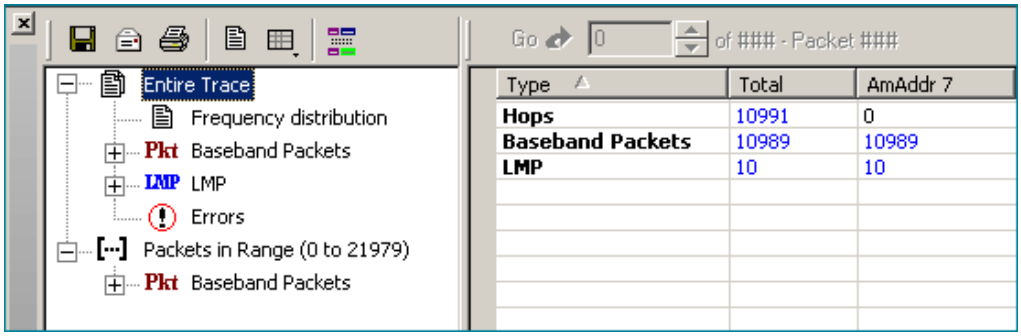
Set as Page Target

Swap Master/Paged Target

For descriptions of these recording modes, see "Synchronization Method" on page 71.

11.3 Traffic Summary

The Traffic Summary dialog box displays a text summary of traffic captured in the current trace.



To open the Traffic Summary window, press .

The left pane displays a tree of the different protocol levels. Click the plus symbol (+) to expand the tree. The example above is fully expanded. The right pane displays a summary of the traffic for the selected level.

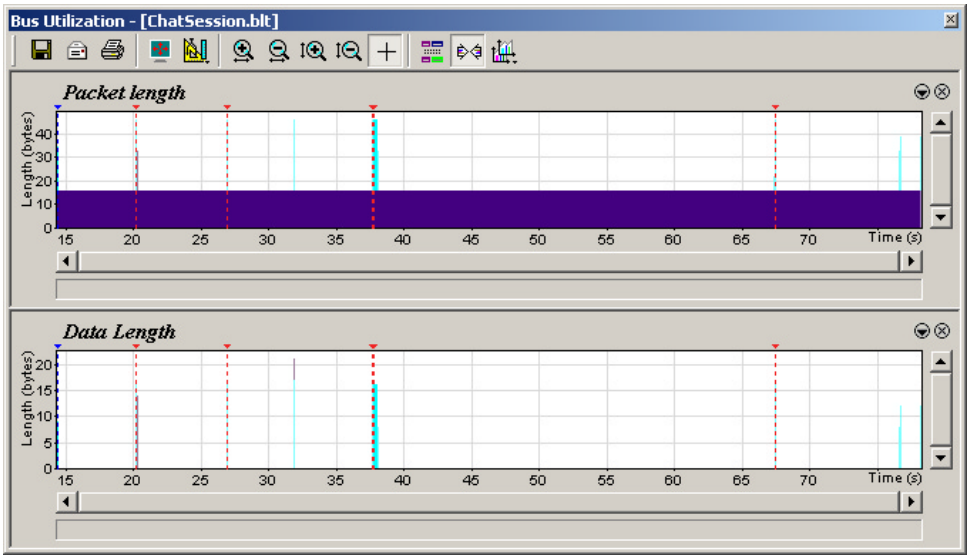
11.4 Error Summary

The Error Summary command opens the **Traffic Summary** dialog box and displays an error summary of the current trace file. The dialog box allows you to go to a specific packet, and save the error file to a uniquely named file. See the discussion below on **Traffic Summary** for more information.

11.5 Bus Utilization

The **Bus Utilization** window displays a graph of bandwidth use within a displayed trace.

To open the Bus Utilization window, select **Report >Bus Utilization** or click the button marked . A window will open with graphs of Link Utilization, Data Throughput, and Packet Counts:



Bus Utilization Buttons

The Bus Utilization window has a row of buttons for changing the format of the displayed data and for exporting data:

The buttons have the following functions:

Save As - Saves the graphs as a bitmap file (*.bmp)

Email - Creates an email with a *.bmp file attachment of the graphs

Print

Full Screen

View Settings - opens a sub-menu with options for formatting the display. See "View Settings Menu" below.

Vertical zoom in

Vertical zoom out

Click and Drag zoom - Click diagonally to select and zoom in on part of the graph

Select Range

Sync and Graph areas - If two or more graphs are displayed, this button will synchronize the graphs to one another. Once synchronized, the positioning slider of one graph will move the other graphs

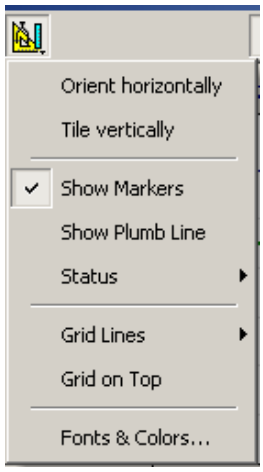
Horizontal zoom in

Horizontal zoom out

Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.

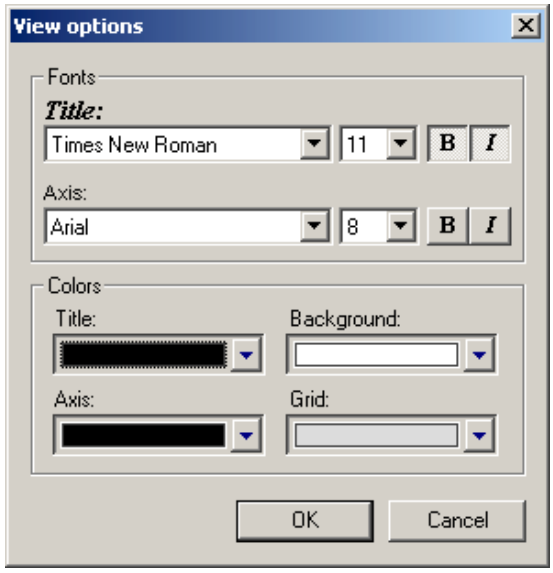
View Settings Menu

Clicking the View settings button causes a menu to open with options for formatting the display.



- **Orient Horizontally** - changes the orientation of bus usage to horizontal. After selecting this option, the menu will say "Orient Vertically."
- **Tile Vertically** - tiles the two graphs vertically (i.e., side by side).
- **Show Markers** - Places "tick" marks along the x axis of each graph.
- Show Plumb Line - Displays a vertical line that connects your cursor to the horizontal axis. As the mouse is moved, the status bar will show the packet and time frame to which the cursor is pointing.
- **Status** - Opens a sub-menu with the following options:
  - — Bar - Displays a status bar at bottom of graph.
  - — Tooltip - Causes a tooltip to appear if you position your mouse pointer over part of the graph and leave it there for a couple of seconds.
  - — None - Turns off tooltips and the status bar.
- **Grid Lines** - Opens a sub-menu with the following options:
  - — Both - Displays both X and Y axis gridlines.
  - — X Axis - Displays X axis gridlines.
  - — Y Axis - Display Y axis gridlines.
  - — None - Turns off gridlines.
- **Grid on Top** - Moves the grid lines above the graph.

- **Fonts and Colors** - Opens a dialog box for setting the colors and fonts used in the graphs:

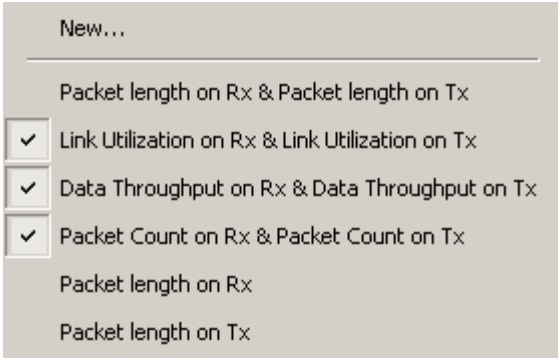


Graph Areas Menu

The Graph Areas menu allows you to view different information in the Bus Utilization window.

Step 1 Click the button.

The Graph Areas menu opens.


New...
Packet length on Rx & Packet length on Tx
Link Utilization on Rx & Link Utilization on Tx
Data Throughput on Rx & Data Throughput on Tx
Packet Count on Rx & Packet Count on Tx
Packet length on Rx
Packet length on Tx

Step 2 Select the data you want to appear in the Graph Areas window.

To change the properties in the Bus Utilizations graph, follow these steps:

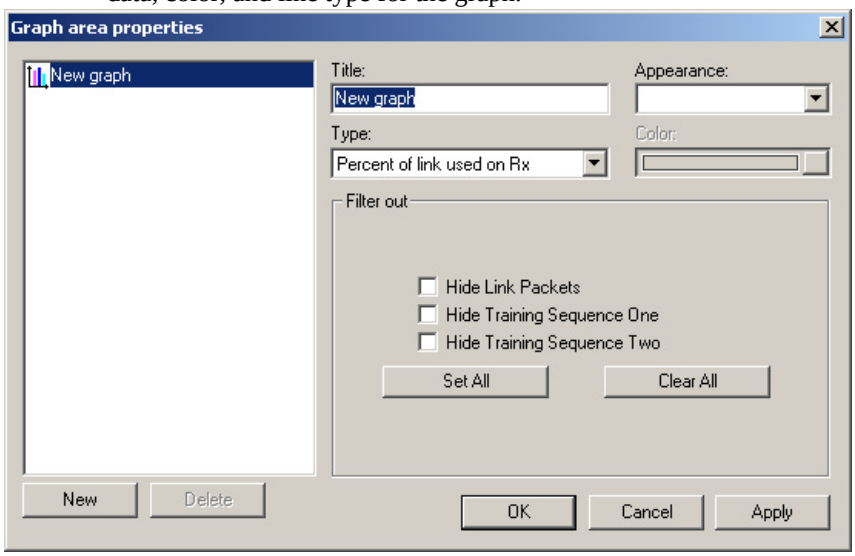
Step 1 In the **Graph Area**s menu, select the type of data to be displayed.

Step 2 Click **OK**.

Or

To make a new graph, click **New**.

The following dialog box will open. It will display options for setting the title, data, color, and line type for the graph.



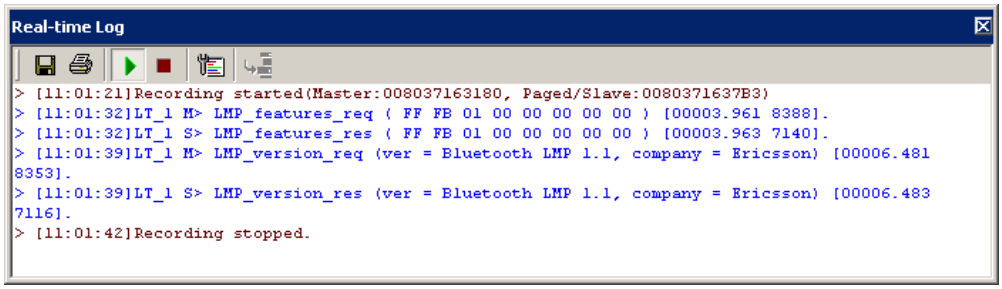
11.6 Real-Time Log

The Real-Time Log is a text-based event logger displaying notifications about system status and Bluetooth traffic events. In order to get the Bluetooth traffic events, the analyzer has to be synchronized to a piconet.

The Real-Time Log window presents the following information in real time:

- System
- Baseband
- LMP Notfications
- L2CAP
- SDP Data
- RFCOMM

To open the Real-Time Log, select **View** > **Real-time log** from the menu.


Real-time Log
> [11:01:21]Recording started(Master:008037163180, Paged/Slave:0080371637B3)
> [11:01:32]LT_1 M> LMP_features_req (FF FB 01 00 00 00 00 00) [00003.961 8388].
> [11:01:32]LT_1 S> LMP_features_res (FF FB 01 00 00 00 00 00) [00003.963 7140].
> [11:01:39]LT_1 M> LMP_version_req (ver = Bluetooth LMP 1.1, company = Ericsson) [00006.481 8353].
> [11:01:39]LT_1 S> LMP_version_res (ver = Bluetooth LMP 1.1, company = Ericsson) [00006.483 7116].
> [11:01:42]Recording stopped.

The window presents six buttons for saving, printing, stopping, starting and customizing the log.

Save As - Saves log to a file.

Stop log.

Print - Prints the open log file.

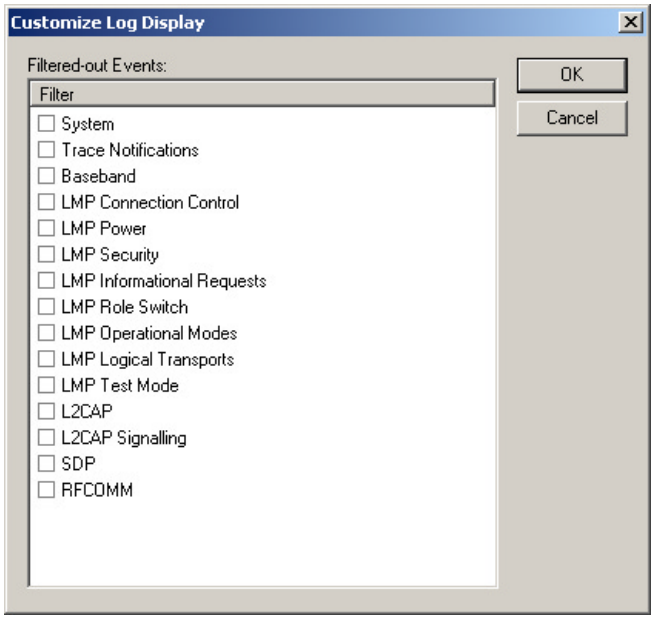
Customize Log. Customizes the types of information being displayed in the log.

Start log.

Insert Marker in trace during a recording.

Customize Log

Clicking the Customize Log button opens a dialog box for selecting the fields displayed in the log.



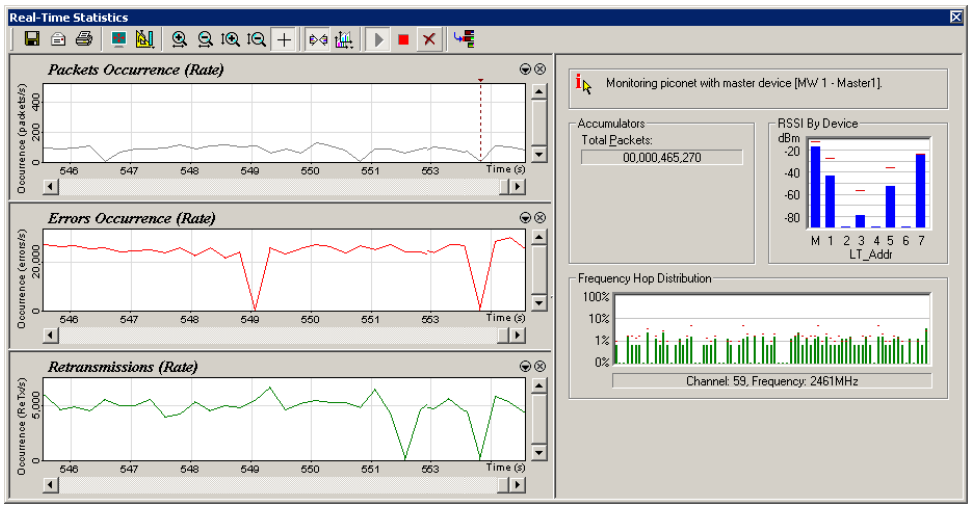
11.7 Real-Time Statistics

The Real-Time Statistics window displays a graph of real-time link activity.

Real Time Statistics displays a summary of the traffic currently being recorded by the analyzer.

To display the Real-Time Statistics window, click in the Tool Bar.

The Real Time Statistics window opens:



In order to see a graph of traffic, you will need to start recording. After starting piconet activity, press to start the Real-Time statistics monitor. Merlin II will then synchronize to the piconet and stream data in real time to this window and presented in a format of your choice.

To stop the monitor, press .

The Real-Time Statistics window is divided into two main areas:

Left-side - Displays time-domain graphs.

Right-side - Displays general statistics and additional information including a bar graph that displays the averaged RSSI readings per device (LT_Addr). This graph is updated periodically only when the analyzer is synced to a piconet.

The General Statistics area presents the following information:

- Status of the system (whether the analyzer is synched, and what device is monitored).
- 'Total Packets' counter that counts the total number of captured packets from the point the RTS started running.
- 'RSSI measurements' – bar graph that shows the averaged RSSI measurements per device in the piconet that is monitored.
- 'Frequency Hop Distribution' – An histogram bar that shows the distribution of actual hops by the frequency channel. Note that this graph is logarithmic.

As in the case of the time-domain graphs, the General Statistics display can be reset through the 'Reset graphs' button.

Real-Time Statistics Buttons

The Real-Time Statistics toolbar has buttons for changing the format of the displayed data and for exporting data:

The buttons have the following functions:

Save As - Saves Real-Time graphs as bitmap files (*.bmp)

Email - Creates an email with a *.bmp file attachment of the graphs

Print

Full Screen

View Settings - opens a sub-menu with options for formatting the display.

Horizontal zoom in

Horizontal zoom out

Vertical zoom in

Vertical zoom out

Click and Drag zoom - Click diagonally to select and zoom in on part of the graph

Select Range

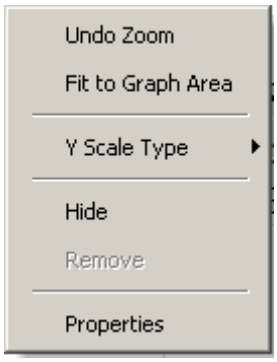
Sync and Graph areas - If two or more graphs are displayed, this button will synchronize the graphs to one another. Once synchronized, the positioning slider of one graph will move the other graphs

Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.

Start. Starts the Real-Time Monitor.

Stop Real-Time Monitoring.

Reset. Resets the graphs.



Real-Time Statistical Monitor Pop-up Menu

If you right-click a graph in the Real-Time window, a pop-up menu will appear with options for changing the format of the display.

Undo Zoom - If you have zoomed in, this command will undo the zoom.

Fit to Graph Area - Redisplays graph so that the entire trace fits inside graph area.

Y Scale Type -·

Linear - Converts display to linear format.

Logarithmic - Converts display to logarithmic format.

Hide - Hides the selected graph.

Properties - Opens a dialog box with options for changing the colors, titles and other features of the graphs.

Displaying Multiple Graphs

The Real Time Statistics window gives you the ability to create up to three separate graphing windows so that you can create separate graphs of traffic and tile them vertically. Within these windows, you can format the graphs in a number of ways.

To view two or three graphs simultaneously, click the **Graph Areas** button.

A menu opens with the following graph options:

- **General Statistics** - Shows/hides stats on right side of window.
- **Packet Occurrence (Rate)**
- **Packet Occurrence (Accumulation)**
- **Errors Occurrence (Rate)**
- **Retransmissions -** This graph shows the rate of retransmitted packets. In the Real-Time Statistics, a packet is evaluated as 'retransmitted' if at least one non-FHS seqn bit has already been received and if the previous sequence bit is the same as the current sequence bit. As the sequence bit toggles on data payloads carrying CRC, the Real-Time Statistics tracks the seqn bits in DM, DV, DH payload, and checks for correctness only if the payload was correctly decoded without errors.

11.8 File Information

The File Information report provides valuable information about how the recording was made, what the buffer settings were, what the trigger options were, and what version of all the analyzer hardware was used to make the recording.

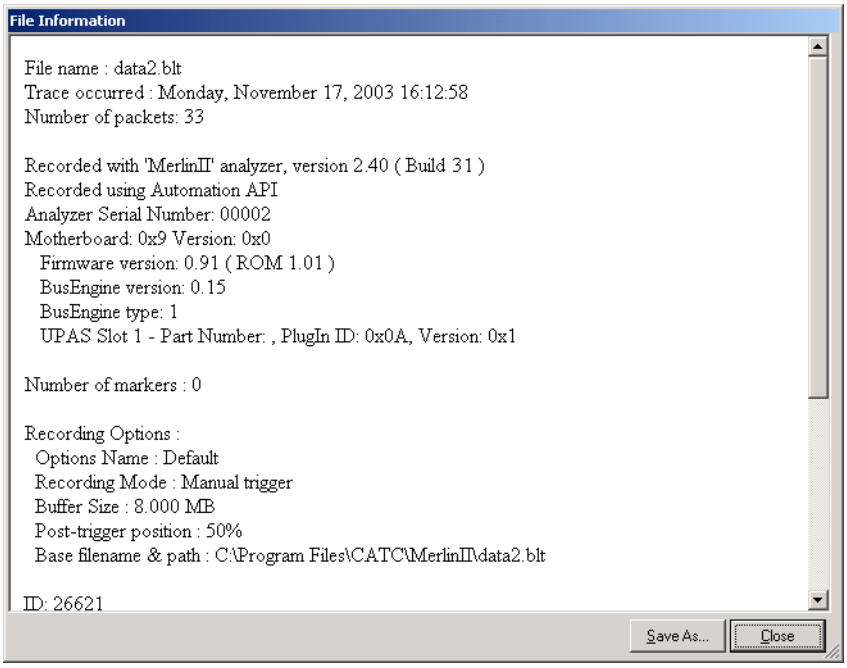
To display a File Information report,

- Select **File Information** under **Report** in the Menu Bar

  OR

  Click in the Tool Bar.

  You see the File Information screen:


File Information
File name : data2.blt
Trace occurred : Monday, November 17, 2003 16:12:58
Number of packets: 33
Recorded with 'MerlinII' analyzer, version 2.40 (Build 31)
Recorded using Automation API
Analyzer Serial Number: 00002
Motherboard: 0x9 Version: 0x0
Firmware version: 0.91 (ROM 1.01)
BusEngine version: 0.15
BusEngine type: 1
UPAS Slot 1 - Part Number: , PlugIn ID: 0x0A, Version: 0x1
Number of markers : 0
Recording Options :
Options Name : Default
Recording Mode : Manual trigger
Buffer Size : 8.000 MB
Post-trigger position : 50%
Base filename & path : C:\Program Files\CATC\MerlinII\data2.blt
ID: 26621
Save As...
Close

11.9 Timing Calculations

Starts the modeless calculator dialog for calculating various timing and bandwidth parameters in the recording file.

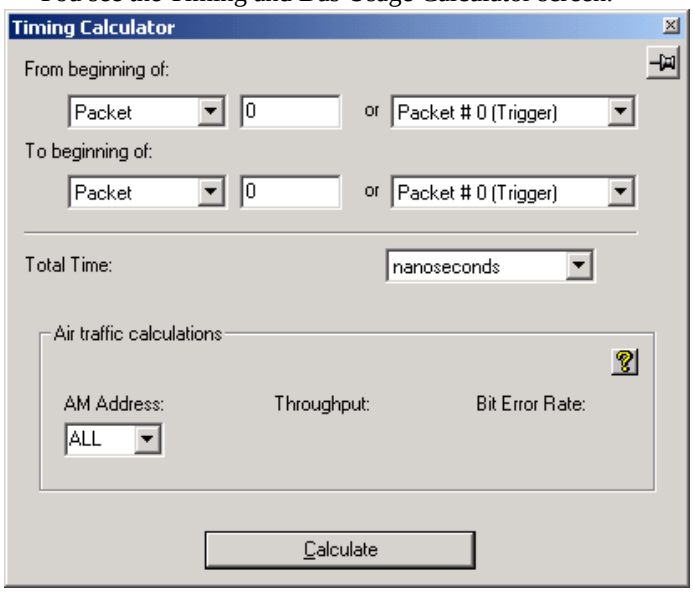
To display a File Information report,

- Select **Timing Calculations** under **Report** in the Menu Bar

  OR

  Click in the Tool Bar.

You see the Timing and Bus Usage Calculator screen:



To calculate bus usage and bit rate errors,

Step 1 Enter the range of packets to be examined in the text boxes marked "From packet" and "To packet."

Step 2 If you wish to limit your calculations to a single device, select the device's address from the LT Address drop-down menu.

Step 3 Click the "Calculate" button.

At this point, bus usage will be calculated.

11.10 Exporting Trace Data

Merlin II has export commands that enable you to extract trace data to CSV, text and other file formats. This chapter describes the export process.

Export commands are accessible through the menu: **File** > **Export**. The Export menu has five options:

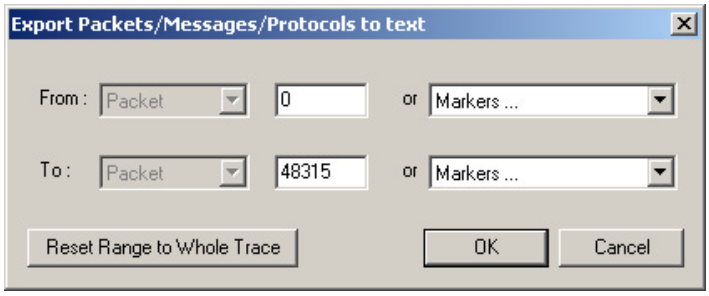
- Packets to Text (Packets View Format) ...
- Packets to CSV Text ...
- Audio Streams ...

11.11 Exporting To Text Format

To export trace data to a text file,

Step 1 Select **File** > **Export** > **Packets to Text (Packet View Format) ...**

The following dialog box opens.



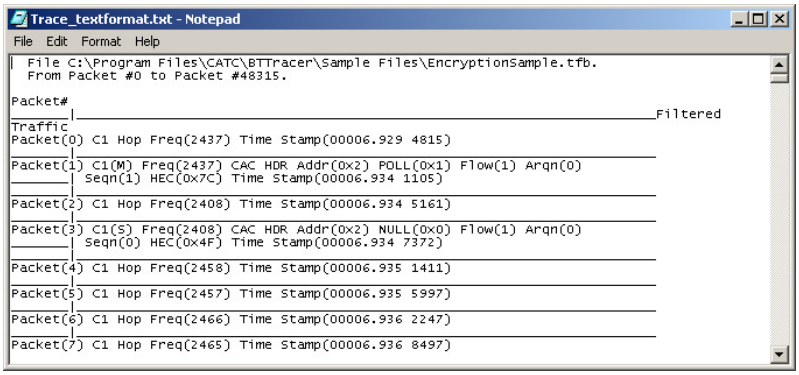
Step 2 Select the type and range of traffic to be searched from the From and To menus

Step 3 Click OK.

A **Save As** dialog box opens.

Step 4 Enter a name for the file and click **OK**.

The file is then saved. Exported text files look like this:


Trace_textformat.txt - Notepad
File Edit Format Help
File C:\Program Files\CATC\BTTracer\Sample Files\EncryptionSample.tfb.
From Packet #0 to Packet #48315.
Packet#
Filtered
Traffic
Packet(0) C1 Hop Freq(2437) Time Stamp(00006.929 4815)
Packet(1) C1(M) Freq(2437) CAC HDR Addr(0x2) POLL(0x1) Flow(1) Arqn(0)
Seqn(1) HEC(0x7C) Time Stamp(00006.934 1105)
Packet(2) C1 Hop Freq(2408) Time Stamp(00006.934 5161)
Packet(3) C1(S) Freq(2408) CAC HDR Addr(0x2) NULL(0x0) Flow(1) Arqn(0)
Seqn(0) HEC(0x4F) Time Stamp(00006.934 7372)
Packet(4) C1 Hop Freq(2458) Time Stamp(00006.935 1411)
Packet(5) C1 Hop Freq(2457) Time Stamp(00006.935 5997)
Packet(6) C1 Hop Freq(2466) Time Stamp(00006.936 2247)
Packet(7) C1 Hop Freq(2465) Time Stamp(00006.936 8497)

11.12 Exporting Trace Data to a .CSV Format

CATC's Merlin II generates over a dozen performance metrics automatically for every trace and measures them in the Traffic Summary, Bus Utilization, and Timing Calculations dialogs. Merlin II also has the ability, however, to extract a far wider range of performance data to a Comma Separated Value **(.csv)** format where it can be analyzed and measured with a spreadsheet, database or other application.

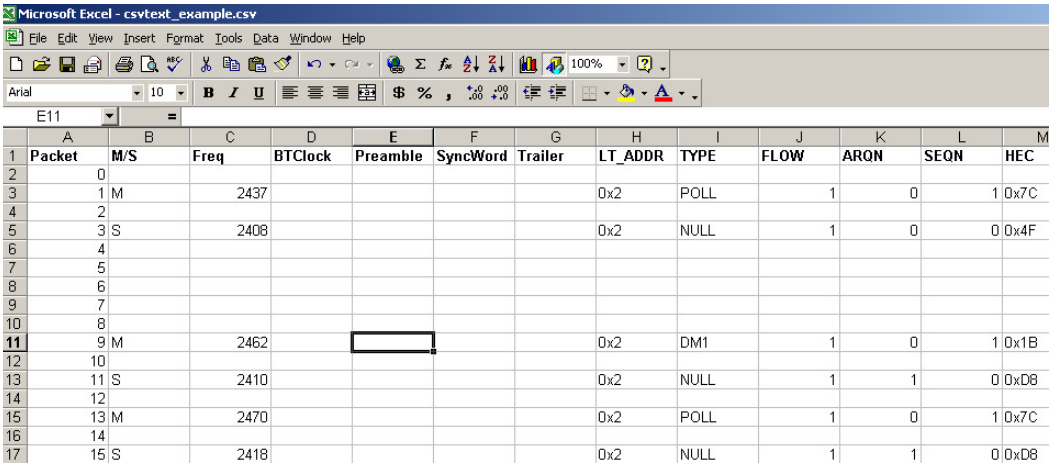
The command that extracts performance data to .csv format is called **Export to CSV Text** and is found under the File menu. This section describes the export process.

Step 1 In Merlin II, open a trace.

Step 2 From the SATracer menu, select F**ile > Export > CSV Text**. The CSV Export dialog box opens.

Step 3 Select a range using the **From** and **To** boxes.

Step 4 Select a folder where you want to export the file, and click **OK.** A **.csv** file will then be created. Below is an example of a .csv file opened in Microsoft Excel.



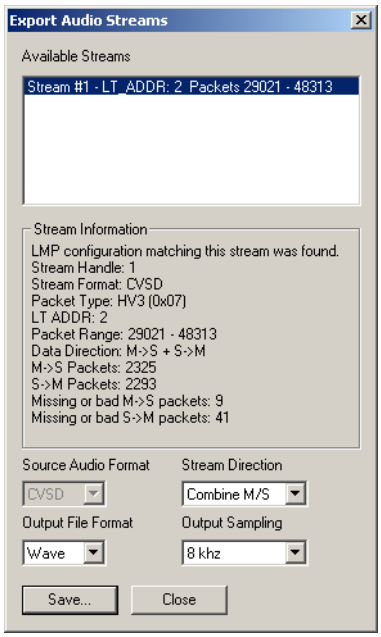
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Packet	M/S	Freq	BTClock	Preamble	SyncWord	Trailer	LT_ADDR	TYPE	FLOW	ARQN	SEQN	HEC
2	0												
3	1	M	2437					0x2	POLL	1	0	1	0x7C
4	2												
5	3	S	2408					0x2	NULL	1	0	0	0x4F
6	4												
7	5												
8	6												
9	7												
10	8												
11	9	M	2462					0x2	DM1	1	0	1	0x1B
12	10												
13	11	S	2410					0x2	NULL	1	1	0	0xD8
14	12												
15	13	M	2470					0x2	POLL	1	0	1	0x7C
16	14												
17	15	S	2418					0x2	NULL	1	1	0	0xD8

11.13 Exporting Audio Data

Merlin II has an **Export Audio Streams** command that allows you to extract audio data from a trace and export it into a file. The command lets you narrow your selection to a particular stream direction (master to slave or slave to master), and to set the output file format and output sampling.

Step 1 Select **File** > **Export > Audio Streams** from the menu.

The dialog box shown right opens.



Source Audio Format - Select the Source format.

Output File Format - Select an output format: WAVE or raw.

Stream Direction - Select stream direction that you wish to capture: Master to Slave, Slave to Master, or both ("Combine M/S").

Output Sampling - Select a sampling rate for the exported audio.

Step 2 Set the parameters, then click **Save**.

A Save As dialog opens.

Step 3 Select the name of the file to be created and its location, then click **OK**.

Appendix A: Merlin II Clock Calibration

The Merlin II system comes with a factory-tuned oscillator used to generated the internal clock. This clock is used for tracking the Bluetooth traffic and has to be kept calibrated.

The following is a detailed procedure for measuring and calibrating the oscillator.

Please do not try to do this calibration without the proper tools. Tempering with the clock calibration might void the warranty on Merlin II.

Tools needed for the calibration:

- The Merlin II system that you want to calibrate.
- Breakout board
- Mini DIN cable to connect the breakout board to the Merlin II
- Frequency counter
- BNC cable to connect the counter to the breakout board.

Steps prior to the procedure

Step 1 Make sure the breakout board is connected to the analyzer.

Step 2 Connect a frequency counter you want to use for the frequency measurement to the 'EXT OUT' BNC connector on the breakout board through a BNC cable. The frequency counter must be able to count frequencies up to 30MHz.

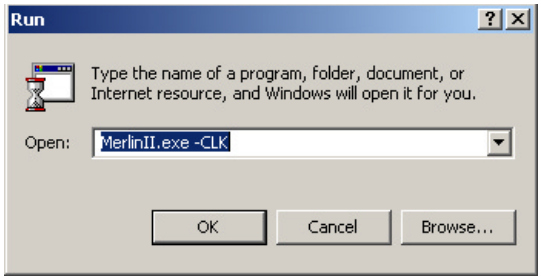
Step 3 Verify that the analyzer is powered and connected to the host machine.

1.1 Procedure:

To be able to access the clock calibration functionality in the application, you should run the Merlin II application from a command line with a -CLK argument:

Step 1 Select **Start** > **Run**.

Step 2 Enter *MerlinII.exe -CLK*



The application appears on the screen.

Step 3 Select **Setup** > **Recording Options** to open the Recording Options dialog box.

Step 4 Set Inquiry Timeout to **0**.

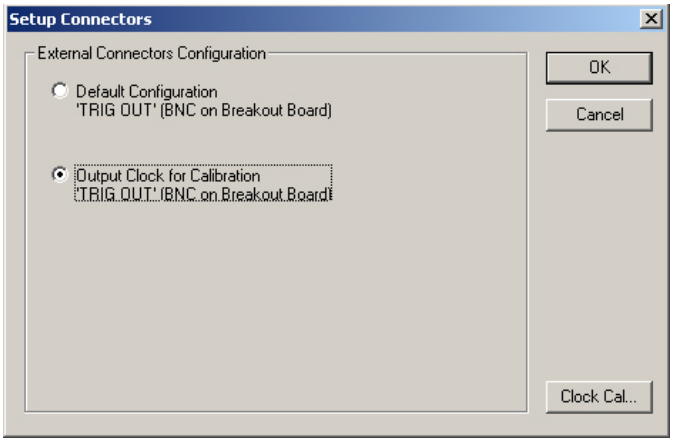
Step 5 Press the Start Recording button run inquiry for at least 5 minutes.

This will bring the analyzer to its operating temperature.

Step 6 Press Stop to stop the inquiry.

Step 7 Select **Setup** >**Connectors** from the menu.

The following window appears:

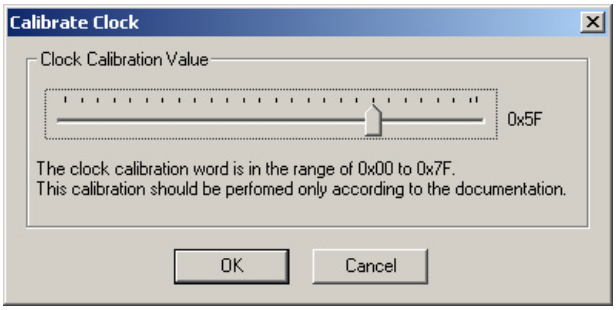


Step 8 Select the option **Output Clock for Calibration**.

At this point the clock signal should be directed to the 'TRIG OUT' BNC connector. The frequency counter should start showing a value around 26 MHz now.

Step 9 Click on the **Clock Cal...** button. Please note that this button is visible only when the Merlin II application is run with the -CLK argument.

The 'Calibrate Clock' window appears:


Calibrate Clock
Clock Calibration Value
0x5F
The clock calibration word is in the range of 0x00 to 0x7F.
This calibration should be perfomed only according to the documentation.
OK
Cancel

Step 10 Set frequency counter to use integration time of at least 1 second.

Step 11 Use the slider to adjust the clock only according to the following steps:

A.Adjust the frequency to 26 MHz (+/- 1ppm), i.e. to a value between 25.99998 MHz and 26.00002 MHz

B.Wait 5 minutes and verify that frequency is still within the range specified in step A.

Step 12 When finished, Click the **OK** button to confirm the setting.

If the calibration value has changed, a pop-up message appears.

Step 13 Select **OK** to cause the application to write the new calibration value to the Merlin II flash memory.

Step 14 In the **Setup Connectors** window select the 'Default Configuration' option and then click on the OK' button.

The **Setup Connectors** window closes.

At this point you can continue with normal operation.

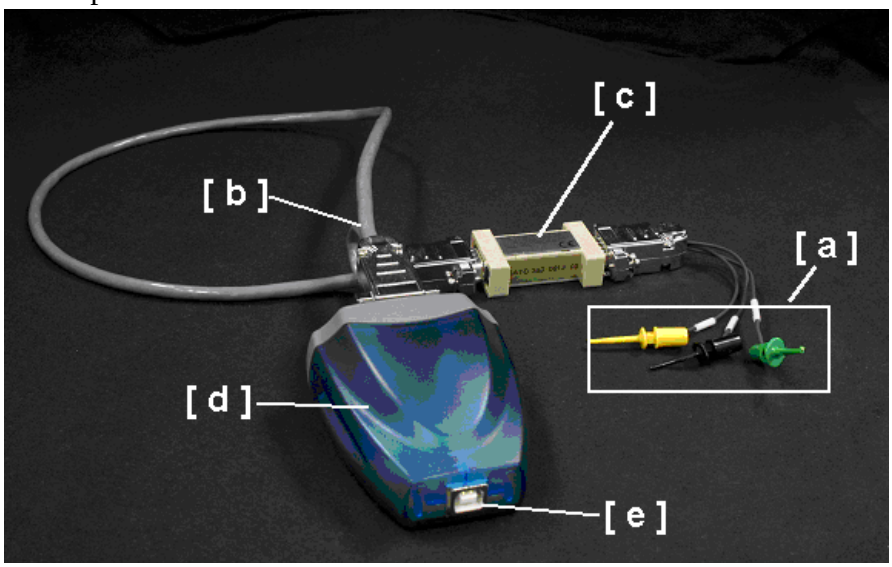
Appendix B: HCI Probe Description

The HCI Probe is used to connect the HCI*Tracer* software to an IUT. If more IUTs are to be monitored, additional HCI Probes should be used. HCI*Tracer* will support up to three HCI probes. It is also possible to forego the probe and connect an IUT to several ports on the host PC. A direct connection between the IUT and the host PC is useful when the PC has high speed serial ports.

The HCI probe can be used in several configurations.

The HCI probe consists of three cables, an RS232 to USB converter, and a TTL to RS232 converter. These components are shown in the photo below. Depending on your test environment, you may need to use all of the components or just some of them.

To monitor RS232 signalling, you use all of the components. To monitor UART signalling, you omit the *TLL to RS232 converter* ("c" in the photo). The steps for connecting the probe components are listed after the following descriptions.



The five probe components consist of:

[a] HCITrace Probe Cable - This cable connects directly to the IUT. This cable has three leads:

- ***Gnd*** – Connects to the reference/ground wire
- ***Host*** – Connects to the wire that carries the down-link traffic from the host to the controller.
- ***BTC***– Connects to the wire that carries the up-link traffic from the controller to the host.

[b] HCITrace RS232 Cable - Has three DB-9 connectors:

- ***RS-232/Probe*** - Connects to the **HCITrace Probe Cable or to the** TTL to RS232 converter (depending whether the signal voltage in the IUT is TTL or RS-232).
- ***COM A*** - Connects to one of the serial inputs of the 2-port RS232 to USB converter.
- ***COM B*** - Connects to one of the other serial input of the 2-port RS232 to USB converter.

[c] TTL to RS232 converter - Use this converter for monitoring TTL signalling. If the signalling is RS-232, omit this converter.

The DB-9 connector on this converter has two markings:

- ***TTL*** - Connects to the **HCITrace Probe Cable.**
- ***RS-232*** - Connects to the 'RS-232'/Probe connector of the **HCITrace RS232 Cable**.

[d] 2-port RS232 to USB converter - This converter is used so the serial signals can be delivered to the host machine through a USB input.

[e] USB cable - Connects the 2-port RS232 to USB converter [d] to the USB port on the host PC.

1.2 Connecting the HCI Probe

The HCI probe can be set up to monitor different types of signalling:

- For monitoring UART level signals
- For monitoring RS232 level signals

Monitoring UART Level Signals

To monitor RS232 level signals, you use the TTL to RS-232 converter. If you plan to connect the probe to a USB port on your PC, you will need to also use the RS232 to USB Converter [d].

To assemble the HCI probe for this configuration, perform the following steps. Refer to the photo and component list shown previously for references to components [a] through [e].

Step 1 Connect the DB-9 connector of the HCITrace Probe Cable [a] to the connector marked with 'TTL' in the TTL to RS-232 converter [c].

Step 2 Connect the DB-9 connector marked with 'RS-232' in the TTL to RS-232 converter [c] to the connector marked with ''RS-232/Probe'' in the HCITrace RS-232 Cable [b].

Step 3 If you intend to connect the RS232 cable directly to a serial port on your PC, do so now. You are now done.

If you are planning to link the probe to your PC via a USB connection, perform the remaining steps.

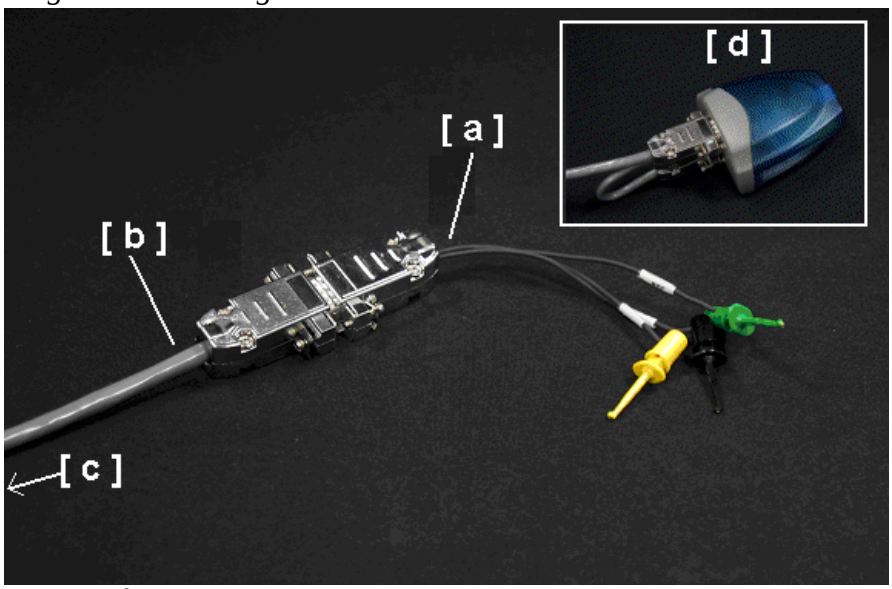
Step 4 Attach 'COM A' in the RS-232 Cable [b] to 'Connector A' on [d], the RS232 to USB converter.

Step 5 Connect the connector marked with 'COM B' in the RS-232 Cable [b] to 'Connector B' in the RS232 to USB converter [d].

Step 6 Connect the USB cable to the RS232 to USB converter [e].

Step 7 Connect the other end of the USB cable to your PC.

Monitoring RS232 level Signals



Legend for photo:

[a] HCI Probe Cable

[b] HCI Trace RS-232 Cable

[c] Connectors A and B on the other end of the HCI Trace RS-232 Cable

[d] Two-Port RS-232 to USB Converter

For monitoring RS232 level signals do not use the TTL to RS-232 converter. To assemble the HCI probe for this configuration, perform the following steps:

Step 1 Connect the DB-9 connector of the HCITrace Probe Cable [a] to the connector marked with ''RS-232/Probe'' in the HCITrace RS-232 Cable [b].

Step 2 If you intend to connect the RS232 cable directly to a serial port on your PC, do so now. You are now done.

If you are planning to link the probe to your PC via a USB connection, perform the remaining steps.

Step 3 Connect 'COM A' in the RS-232 Cable [c] to 'Connector A' in the RS232 to USB converter [d].

Step 4 Connect 'COM B' in the RS-232 Cable [b] to 'Connector B' in the RS232 to USB converter [d].

Step 5 Connect the USB cable to the RS232 to USB converter [e].

Step 6 Connect the other end of the USB cable to your PC.

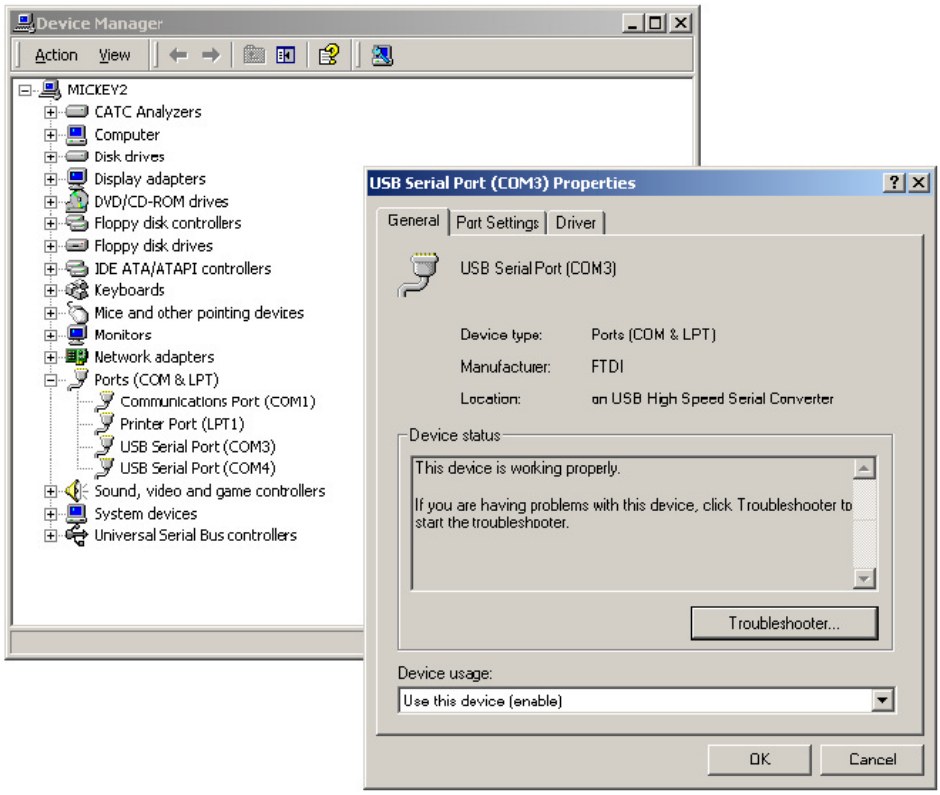
2-port RS232 to USB converter

The 2-port RS232 to USB converter [d] allows the user to connect two serial connectors to the host machine via a single USB connection. When connected to the host PC, the converter emulates two separate virtual COM ports that can be used as other real COM ports.

To connect the HCI probe to the host PC, you will need to install several drivers. The drivers are provided on the installation CD-ROM in the HCI Probe\Drivers sub directory.

Once the converter is connected to a host machine the user is prompted to provide the place where the system can install the drivers from.

After installing the drivers two new COM ports are going to be available, as seen in the following snapshot of the Device Manager.



Appendix C: Export Audio Streams

The 'Export Audio Streams' command exports audio streams from a trace file into two different file formats: RAW and WAVE.

The WAVE file format is Windows' native file format for storing digital audio data. WAVE has become one of the most widely supported digital audio file formats.

WAVE files use a standard structure called Resource Interchange File Format (RIFF) that groups the files contents (sample format, digital audio samples, etc.) into separate chunks, each containing it's own header and data bytes. The chunk header specifies the type and size of the chunk data bytes.

1.3 File Structure

There are three chunks used for CATC WAVE file generated by the CATC Bluetooth analyzer applications:

RIFF Chunk Type

Wave file headers follow the standard RIFF file format structure. The format of interest here is "WAVE," which requires two sub-chunks" "fmt" and "data."

Format Chunk - "fmt "

Describes the format of the sound info in data sub-chunk.

Data Chunk - "data"

The "data" sub-chunk Indicates the size of the sound information and contains the raw sound data.

The following is the WAVE file format that is used by the 'Export Audio Streams' functionality to generate the audio files. The right-most column describes the data as being put by the CATC Bluetooth analyzer application.

Field Name	Endian	File Offset	Field Size	Field Description	CATC Data
ChunkID	Big	0	4	Contains the letters "RIFF" in ASCII form (0x52494646 big-endian form). RIFF stands for "Resource Interchange File Format."	"RIFF"
ChunkSize	Little	4	4	36 + SubChunk2Size, or more precisely: 4 + (8 + SubChunk1Size) + (8 + SubChunk2Size) This is the size of the entire file in bytes minus 8 bytes for the two fields not included in this count: ChunkID and ChunkSize.	Calculated when file is created.
Format	Big	8	4	Contains the letters "WAVE" (0x57415645 big-endian form).	"WAVE"

Field Name	Endian	File Offset	Field Size	Field Description	CATC Data
Subchunk1ID	Big	12	4	Contains the letters "fmt" (0x666d7420 big-endian form).	'f', 'm', 't', ''
Subchunk1Size	Little	16	4	16 for PCM. This is the size of the rest of the Subchunk, which follows this number.	0x12
AudioFormat	Little	20	2	PCM = 1 (i.e. Linear quantization) Values other than 1 indicate some form of compression.	1
NumChannels	Little	22	2	Mono = 1, Stereo = 2, etc.	Num of actual channels as selected by the user: 1 or 2.

Field Name	Endian	File Offset	Field Size	Field Description	CATC Data
SampleRate	Little	24	4	The number of sample slices per second. This value is unaffected by the number of channels: 8000, 44100, etc.	Sample Rate as selected by the user: 8K or 64K
ByteRate	Little	28	4	This value indicates how many bytes of wave data must be streamed to a D/A converter per second in order to play the wave file. This information is useful when determining if data can be streamed from the source fast enough to keep up with playback. This value can be easily calculated with the formula:	SamplesPerSec *.BlockAlign
BlockAlign	Little	32	2	The number of bytes for one sample including all channels.	Channels * (BitsPerSample / 8)
BitPerSample	Little	34	2	This value specifies the number of bits used to define each sample. This value is usually 8, 16, 24 or 32.	16
ExtraParamSize	Little	36	2	This value specifies how many additional format bytes follow. It does not exist if the compression code is 0 (uncompressed PCM file) but may exist and have any value for other compression types depending on what compression information is need to decode the wave data. If this value is not word aligned (a multiple of 2), padding should be added to the end of this data to word align it, but the value should remain non-aligned.	0
ExtraParams (Optional)		38	X	Space for extra parameters	This field is not present in CATC generated WAV files.

Field Name	Endian	File Offset	Field Size	Field Description	CATC Data
Subchunk2ID	Big	36	4	Contains the letters "data" (0x64617461 big-endian form).	"data"
Subchunk2Size	Little	40	4	== NumSamples * NumChannels * BitsPerSample/8 This is the number of bytes in the data. You can also think of this as the size of the read of the subchunk following this number.	Calculated when file is created
Data	Little	44	Subchunk2Size	The actual sound data.	Actual exported audio data

1.4 Compatibility

In addition to the "canonical" standard of WAVE files format you might find many other dialects and interpretations to the file format. While some tools are capable of reading various WAVE file formats, some would not.

Most of the latest media player applications should be able to open and play the WAVE files generated by CATC's "Export to Audio". However, if you encounter a case where an application was not capable of doing this, you can try and do one of the following steps:

- Try and open the WAVE file and re-save it through an intermediate media application. For instance, try and use the 'Sound Recorder' application that is bundled with Microsoft® Windows to open the file and save it back. Such an operation might modify some of the header parameters and make the file suitable for your specific set of tools.
- Find a 3rd party audio file conversion tool that would again modify the file's format and make it suitable for your tools. Such applications can be found (many as freeware) over the Internet.

How to Contact CATC

Type of Service	Contact
Call for technical support…	US and Canada: 1 (800) 909-2282 Worldwide: 1 (408) 727-6600
Fax your questions…	Worldwide: 1 (408) 727-6622
Write a letter…	Computer Access Technology Corp. Customer Support 3385 Scott Blvd Santa Clara, CA 95054
Send e-mail…	support@CATC.com
Visit CATC's web site…	http://www.CATC.com/

Limited Hardware Warranty

So long as you or your authorized representative ("you" or "your"), fully complete and return the registration card provided with the applicable hardware product or peripheral hardware products (each a "Product") within fifteen days of the date of receipt from Computer Access Technology Corporation ("CATC") or one of its authorized representatives, CATC warrants that the Product will be free from defects in materials and workmanship for a period of three years (the "Warranty Period"). You may also complete your registration form via the internet by visiting http://www.catc.com/support/register/. The Warranty Period commences on the earlier of the date of delivery by CATC of a Product to a common carrier for shipment to you or to CATC's authorized representative from whom you purchase the Product.

What this Warranty Does Not Cover

This warranty does not cover damage due to external causes including accident, damage during shipment after delivery to a common carrier by CATC, abuse, misuse, problems with electrical power, including power surges and outages, servicing not authorized by CATC, usage or operation not in accordance with Product instructions, failure to perform required preventive maintenance, software related problems (whether or not provided by CATC), problems caused by use of accessories, parts or components not supplied by CATC, Products that have been modified or

altered by someone other than CATC, Products with missing or altered service tags or serial numbers, and Products for which CATC has not received payment in full.

Coverage During Warranty Period

During the Warranty Period, CATC or its authorized representatives will repair or replace Products, at CATC's sole discretion, covered under this limited warranty that are returned directly to CATC's facility or through CATC's authorized representatives.

How to Obtain Warranty Service

To request warranty service, you must complete and return the registration card or register via the internet within the fifteen day period described above and report your covered warranty claim by contacting CATC Technical Support or its authorized representative. CATC Technical Support can be reached at 800-909-7112 or via email at support@catc.com. You may also refer to CATC's website at http://www.catc.com for more information on how to contact an authorized representative in your region. If warranty service is required, CATC or its authorized representative will issue a Return Material Authorization Number. You must ship the Product back to CATC or its authorized representative, in its original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. CATC must receive the Product prior to expiration of the Warranty Period for the repair(s) to be covered. CATC or its authorized representative will thereafter ship the repaired or replacement Product to you freight prepaid by CATC if you are located in the continental United States. Shipments made outside the continental United States will be sent freight collect.

Please remove any peripheral accessories or parts before you ship the Product. CATC does not accept liability for lost or damaged peripheral accessories, data or software.

CATC owns all parts removed from Products it repairs. CATC may use new and/or reconditioned parts, at its sole discretion, made by various manufacturers in performing warranty repairs. If CATC repairs or replaces a Product, the Warranty Period for the Product is not extended.

If CATC evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, CATC will inform you of its determination. If you thereafter request CATC to repair the Product, such labor and service shall be performed under the terms and conditions of CATC's then current repair

policy. If you chose not to have the Product repaired by CATC, you agree to pay CATC for the cost to return the Product to you and that CATC may require payment in advance of shipment.

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